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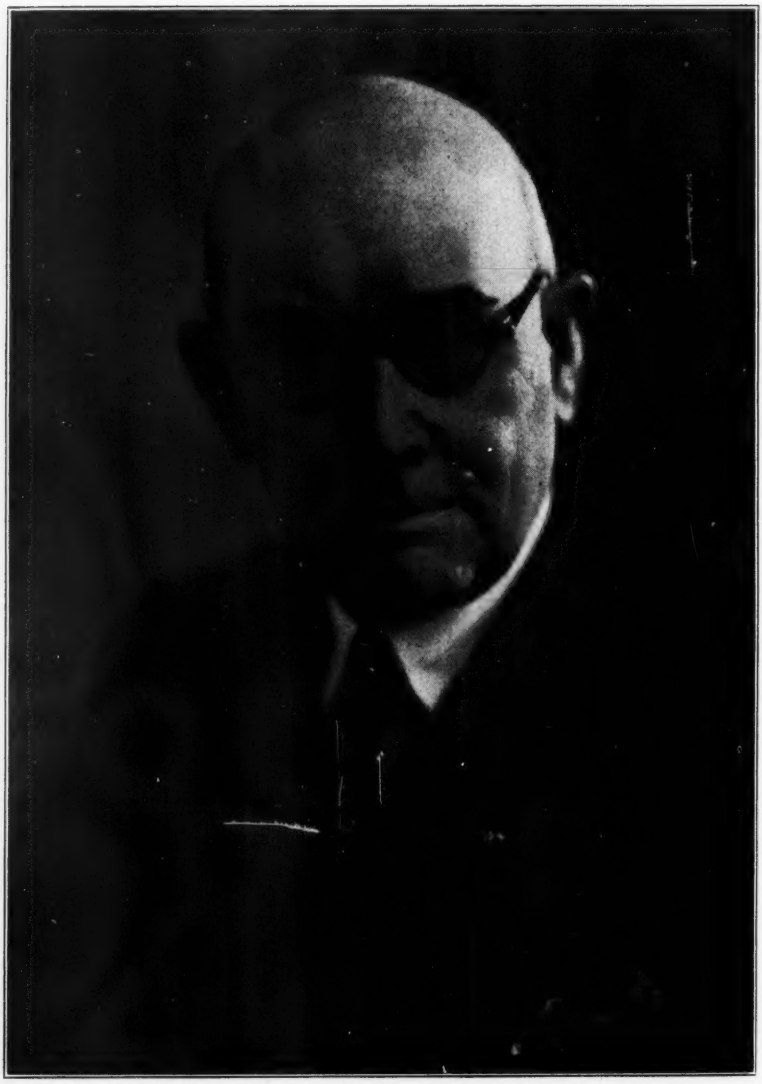

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Original Communications

HISTOLOGIC PHENOMENA OF TOOTH TISSUES AS OBSERVED UNDER POLARIZED LIGHT; WITH A NOTE ON THE ROENTGEN-RAY SPECTRA OF ENAMEL AND DENTIN*

By A. TREGONING CAPE, A.R.S.M., and
PAUL C. KITCHIN, B.S., M.S., D.D.S., Columbus, Ohio

THE title "Histologic Phenomena of Tooth Tissues as Observed Under Polarized Light and Between Crossed Nicols" is, strictly speaking, incorrect. For the last three words, the phrase "in polarized light and between crossed Nicols" should be substituted. The title form is used as it is in a general way more explanatory of the nature of the paper than the technical phrasing. Polarized light refers to the unidirectional nature of the vibration at right angles to the direction of propagation of the ray, and "crossed Nicols" is the application of the phenomenon to the special case of resolving phase differences in two rays passing through anisotropic mediums, giving the phenomenon of interference colors.

The use of polarized light as a means for the identification of crystalline material has been limited largely, until recent years, to the field of mineralogy. So specialized has been this application that microscopes fitted with polarizing equipment are in general described as petrographic. Recently, the technic has elucidated problems in identity, structure and the arrangement of the crystalline phases in fields as diversified as the manufacture of ceramic ware and refractories, the study of chemical equilibriums and in the manufacture of chemicals and drugs. (The new pharmacopeia is to give, where

*From the research laboratory of the dental school of the Ohio State University, Paul C. Kitchin, director.

*Read before the Research Session at the Sixth Annual Meeting of the American Association of Dental Schools, Chicago, Ill., March 26, 1929.

known, the optical properties of substances.)

The literature has but few references to the uses of this technic in the study of histologic problems. J. Howard Mummery[1] on page 56 of his book refers to the wing structure of enamel rods as being highly calcified from evidence obtained by the examination of thin sections under polarized light. The statement made may be true, but the phenomenon of crystallinity is not confined to inorganic compounds, for such materials as cellulose, keratinized tissues, in such places as cow's horn, and the stratum corneum of the skin and in the nails are crystalline. On page 272, he further states that Guido Fischer and von Ebner considered "that the collagen fibers of the dentine substance are arranged at right angles to the dentinal tubes, that they are not gelatine yielding and do not show double refraction."

Before describing the phenomena observed, an account will be given of the theory of double refraction, petrographic microscopic equipment and the criteria used for identification.

DOUBLE REFRACTION

Nonopaque substances may be divided into two classes: (1) those in which light is propagated in all directions at equal velocities and (2) those in which the velocity of light varies with the direction of propagation. The first class comprises isotropic crystals and so-called amorphous materials. The second class are known as the anisotropic crystals and are divided into two groups: (1) the uniaxial and (2) the biaxial. Crystals of this second class are also known as double refracting.

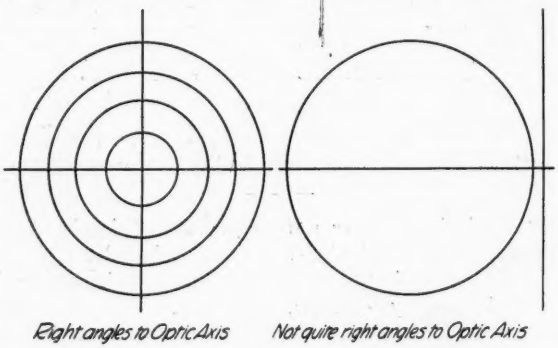

Fig. 1.—Interference figures in uniaxial crystals. In biaxial figures the bars are curved. (For further description see Johnnsen, Albert: Manual of Petrographic Methods, New York, 1916. Edwards, M. G.: Introduction to Optical Mineralogy and Petrography, Cleveland, 1916. Weinscheck, Ernst: Petrographic Methods, New York, 1912.)

Uniaxial crystals have one direction, known as the optic axis, in which direction of transmission there is no double refraction. This is the direction of the vertical axis. In biaxial crystals, there are two optic axes. Hexagonal and tetragonal crystals are uniaxial, while orthorhombic, monoclinic and triclinic crystals are biaxial.

Double refraction or birefringence is the property peculiarly possessed by crys-

1. Mummery, J. H.: Microscopic and General Anatomy of the Teeth, London: Oxford University Press, 1924.

tals of resolving incident light as it passes into the crystal into two rays vibrating at right angles to each other. These two rays as they pass through the crystal possess different velocities (the linear velocity of light is inversely proportional to the indices of refraction of the transmitted light). This difference in the linear velocity of these two rays is caused by a change in their wave length as they pass through the crystal; and as they issue from the crystal, there will be a phase difference between the two rays. Since these two rays are vibrating at right angles to each other as they issue from the crystal, there will be no visible effect of this phenomenon. As these two rays pass into the upper Nicol (or analyzer), they are reduced to a common vibration direction, and the effect of the phase difference is seen in that the crystal appears as a bright colored grain in an otherwise black field.

The color reaction is caused by the reduction of the rays to a common vibration direction where the phase difference may be of such magnitude as to cause complete interference (and elimination) of certain of the components of white light. The resulting color phenomenon is due to white light from which has been eliminated those components (or wave lengths) where there is a phasal difference of a half wave length. As the stage of the microscope is rotated, these color reactions do not change, though the intensity varies, but at certain positions of rotation (90 degrees apart), the crystal cannot be seen. This position is called the position of extinction, and a crystal is at the position of extinction when the vibration direction of the two rays pass-

Fig. 2.—Human enamel in polarized light and between crossed Nicols, showing general uniformity of crystal orientation. (× 130.)

ing through the crystal are parallel to the vibration directions of two polarizers, or Nicols.

In uniaxial crystals, one of the two rays transmitted always has a constant value for the index of refraction (the velocity is constant and independent of the direction of transmission). This ray is called the ordinary ray. The index of refraction of the other ray varies with the direction of transmission. In biaxial crystals, neither of the two rays has a constant value, but the values vary for different direction of light transmission in the crystal.

POLARIZING AND ANALYZING EQUIPMENT

Placed below the stage of the microscope is a Nicol prism also known as the polarizer, and made of a crystal calcite. The Nicol prism is so constructed that one of the two rays is totally reflected, while the second ray passes through completely polarized and with a known direction of vibration.

Fig. 3.—Human enamel and dentin in polarized light and between crossed Nicols. *A*, "first order white" band in enamel at dentino-enamel junction. *B*, affected dentin, isotropic. *C*, affected dentin, "luminously" birefringent. *D*, normal dentin. The very first stages of decay are manifest as penetrating from the enamel to the dentin near *B*. (× 130.)

The upper Nicol—the analyzer—is placed so that its vibration direction is at right angles to that of the lower Nicol. With a double refracting material placed on the microscope stage, the ray coming

from the polarizer is resolved by the crystal into two rays. These two rays as they pass into the upper Nicol are resolved into common vibration directions, and those components of each of these rays, which vibrate in the vibration direction of the upper Nicol, pass through the upper Nicol. As the light passes through the crystal on the stage of the microscope, the slow ray is retarded by some part of a wave length behind the fast ray, and this phase difference, when the two rays are reduced in the upper Nicol to a common vibration direction, produce the beautiful interference colors characteristic of crystalline material when viewed in polarized light between crossed Nicols. The interference color is a function of this difference. The color is dependent on (1) the birefringence of the crystal, which is an innate property, (2) the direction of light transmission through the crystal and

Fig. 4.—Sketch of human enamel and dentin viewed in polarized light and between crossed Nicols. *A*, "white" band at dentino-enamel junction. *B*, area of lower birefringence. *C*, "white" outer portion.

(3) the thickness of the crystal. On rotating the stage of the microscope, blackness occurs four times in every revolution. At this position, the vibration directions of the crystal are parallel to the vibration directions of the Nicols, and only one ray of light is transmitted through the crystal grain, at this position; that is, the ray vibrating parallel to the vibration direction of the lower Nicol. Necessarily at this position, since there is only one ray transmitted, there can be no birefringence.

If, instead of using parallel light, convergent polarized light is used, and the ocular is removed, the crystal itself is not seen, but interference bands are observed moving across the field as the stage of the microscope is revolved. In order to produce this effect, the condenser is brought into position and up close to the crystal. Both the polarizer and the analyzer are in position, and the ocular is removed and a diaphragm with a small hole in the center takes its place. If the section observed is close to an optic axis, as in a uniaxial figure, straight bars are seen to sweep across the field, and the bars are parallel to one or the other of the vibration directions of the Nicols.

Fig. 5.—Human enamel section, identical with Figure 6, seen in ordinary light. Note "land-mark" at dentino-enamel junction. (× 130.)

From the interference figures, it is possible to determine the orientation of the crystal in the section under consideration. By means of a selenite plate or a quartz wedge introduced into the optical system, it may be determined whether the

ray which is vibrating in the direction of the optic axis is the ray with the high index of refraction. The ray which vibrates in the trace of the optic axis of a uniaxial mineral is called the extraordinary ray. Similarly, it can be determined whether the vibration direction of the ray with high index of refraction is in the acute bisectrex. In these two cases, the crystals are positive.

The criteria for the determination of the rays with high or low index are as follows: 1. If the high ray of the inserted selenite plate is parallel to that of the high ray of the crystals, there is an increase of the interference color, a rise from red to blue or from colors of one order to those of a higher order. 2. If the high ray of a selenite plate is parallel to the low ray of the crystal, there is a decrease in the interference color or a change from red interference color of the selenite plate to yellow.

The technic for the complete identification of crystalline materials includes the following determinations: 1. The measurement of the refractive indices: *(a)* One index in an isotropic material (isometric). *(b)* Two indices of an uniaxial crystal (hexagonal and tetragonal. *(c)* Three indices in a biaxial crystal (orthorhombic, monoclinic and triclinic).

2. The measurement of the birefringence. This is included in determination 1, but measurement is often made directly.

3. The determination of the extinction

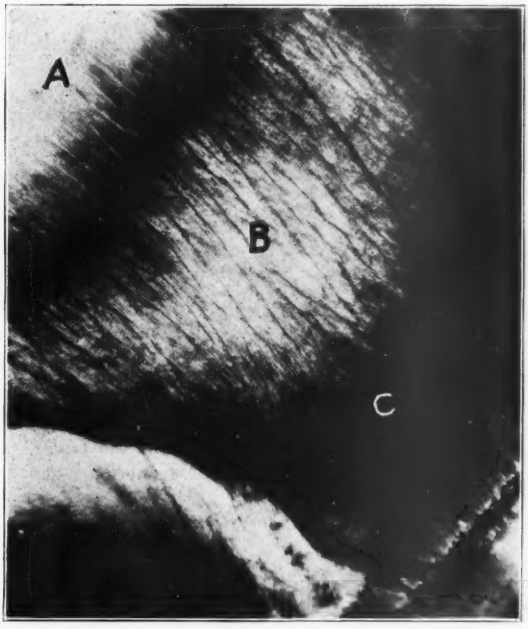

Fig. 6.—Human enamel viewed in polarized light and between crossed Nicols. *A*, normal, on negative enamels, grayish white. *B*, positive enamel, yellow interference color. *C*, isotropic enamel. (× 130.)

angle. This is the angle between the vibration direction of the crystal determined from its position of extinction, and a crystallographic direction such as the direction of elongation of the crystal fibers. The directions of the Nicols are usually parallel with the cross hairs of the eye piece, and when the crystal is at the position of extinction; therefore, the vibration direction of the crystal is parallel to the cross hairs. (Hexagonal tetragonal and orthorhombic, straight and symmetrical extinction; monoclinic and triclinic, inclined extinction.)

4. The identification by interference figures of the type of crystal. This differentiates between uniaxial and biaxial crystals.

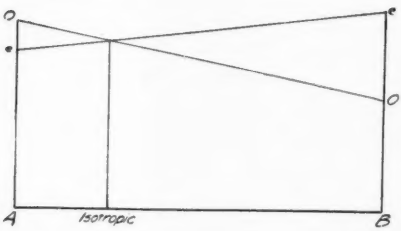

Fig. 7.—Effect of changing concentration of solid solution on indices of refraction and optical sign of crystalline substance of enamel.

5. The determination of the sign of the crystal.

6. The sign of elongation, the vibration of the high ray with respect to the direction of elongation of the crystal.

7. In biaxial minerals, the angle between the optic axes: 2V—actual angle; 2E—apparent angle measured in air.

The complete and accurate determination of the foregoing optical properties of a known crystalline phase is proof of its identification. Where the crystal has not been previously described, it is the criterion for its differentiation from other crystals.

In applying this technic to tooth structures, the present part of the work is confined not to the exact statement of the optical properties of the phases present, but to general observations, the differentiation of phases and the changes taking place under varying conditions. The indices of refraction are measured approximately while identity is established by (*a*) interference colors, (*b*) the sign of the crystal and (*c*) the sign of elongation.

We feel that the technic has brought to light conditions which had not heretofore even been suspected, and may contribute materially to the explanation of phenomena well recognized by other means. We offer the following observations to stimulate discussion of the problem and perhaps to arouse interest in a method whose use in the hands of other observers may be prolific of results. While little is claimed for the theories here advanced, much is claimed for the possibilities of the technic.

The evidence given in the note on the ray spectra data is conclusive as to the exactly similar nature of the crystalline deposits in the enamel and the dentin. The explanation is advanced that the differences in composition which exist are slight, being undetectable by any change of the lattice, but that the difference in the indices of refraction between the enamel and the dentin is due to the salts being held colloidally in the dentin, and the index found is in the main the index of the organic material and not of the salt. Evidence for this will be given in the account of the phenomena observed in the dentin.

We feel a debt of gratitude to Dr. William J. McCaughey, professor of mineralogy, Ohio State University, for his inspiring teaching of the use and significance of petrographic microscopy and

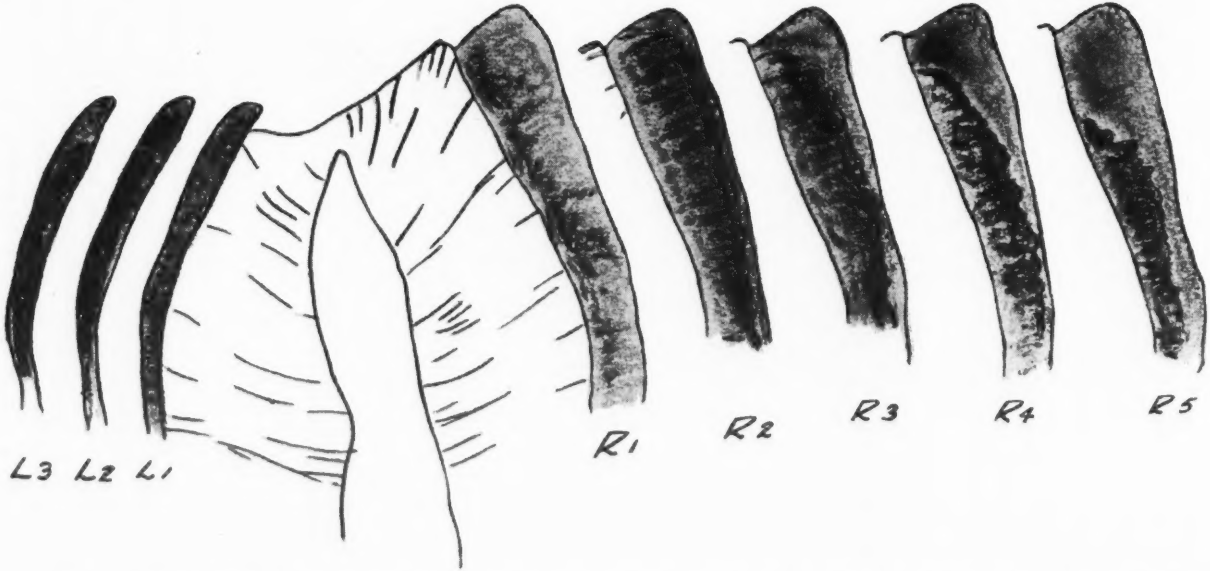

Fig. 8.—Stages of decalcification as viewed in polarized light, between crossed Nicols and with selenite plate. Note reversal of colors on opposite sides of tooth. On right yellow-negative, blue-positive, red-isotropic. On left blue-negative, yellow-positive, red-isotropic.

his clear exposition of chemical equilibriums, particularly that most subtle phenomenon, solid solution. We wish to thank him for the loan of equipment and for his corrections in the introduction of this paper. This far we know that we are correct; for the rest, we have attempted to describe phenomena which may be of some interest to dental histologists. As for the conclusions that we have drawn, we wish in no way to implicate Dr. McCaughey in our errors.

Fig. 9.—Between crossed Nicols; first stage of decalcification. The lines of Schreger are clearly visible, with the white band at the dentino-enamel junction. (× 130.)

THE ENAMEL

The examination of tooth sections in polarized light between crossed Nicols is complicated by the low birefringence of the crystals. As the phenomena are of interest because of obvious differences, a very thin section is often not suitable, while a thicker one, though it emphasizes the differences, introduces the difficulty that the lower layers of rods may not be parallel to the upper, and usually are not exactly parallel. Care must be taken therefore to examine the thicker sections for the change in direction of underlying rods before any conclusions are drawn as to birefringence. There is a general uniformity of orientation of the crystalline material of the rods. The rotating roentgen-ray photograph does not indicate entirely uniform orientation. If that were the case, well-defined spots would be found on the film, but the marked intensity of the curves along the zero axis shows a preferential orientation. Figure

2 substantiates the roentgen-ray evidence. The main mass of enamel is light with a few small areas in extinction. On rotating the microscope stage, the main bands of extinction move around with the change in direction of the rods themselves. This would suggest that the orientation of the crystals with respect to the individual rods is the same. It is probable that a straight rod is homogeneous, and that sides of the discontinuity are invariably oriented in the same direction. These discontinuities constitute, when occurring in a series of consecutive rods, the striae of Retzius.

The note on the roentgen-ray work offers evidence as to the exactly isomorphous character of the inorganic crystalline material of the enamel and the dentin with the mineral apatite. Apatite

Fig. 10.—Between crossed Nicols; stage of decalcification. The light portion of the section is positive enamel, the dark isotropic. Birefringency of secondary cuticle is evident. (× 130.)

rods laid in the same general direction are similarly oriented. Discontinuities do occur in rods. There is a change in the material laid down, sometimes of higher birefringence, sometimes lower, isotropic, of different color and material of different optical characteristics; and, in these cases, the materials laid down on both is hexagonal; therefore, the enamel and dentin contain hexagonal crystals. In the dentin, the probably colloidal form of the inorganic material prevents its being observed by ordinary methods. The enamel crystals are well developed.

J. Howard Mummery[2] states: "Cal-

2. Footnote 1; second edition, p. 129.

cification of enamel may be considered as essentially the transference of soluble colloids in the blood into insoluble colloids in a fibrillar matrix." Our work leads us to believe that the enamel is not an insoluble colloid but is composed of a mass of crystals, of appreciable microscopic size, whose optical properties are measurable and definite. Furthermore, the relation of the crystal orientation to the rod direction is significant.

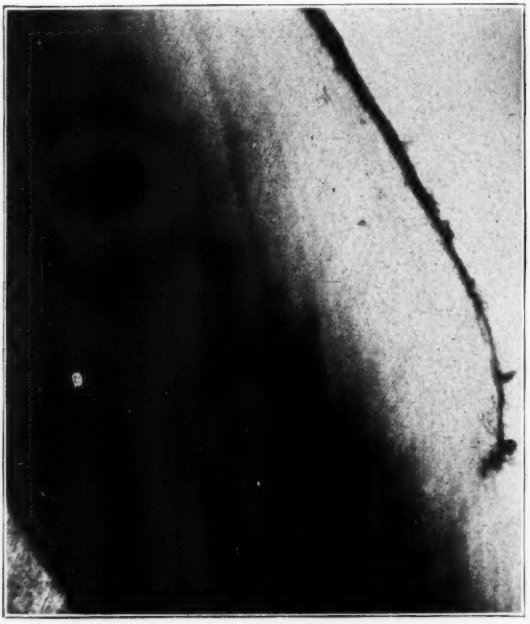

Fig. 11.—Between crossed Nicols. Stage of decalcification, taken with selenite plate to indicate sign of elongation. (× 130.)

If the crystallographic axis of the crystal is parallel to the rod direction or at right angles to it, extinction would take place where the long direction of the rod is parallel to the cross hairs of the ocular. This is not the case; the c axis is at an acute angle to the long direction. In canine enamel, the extinction takes place parallel to the cross hairs. It is inconceivable that this is mere chance, and there is every reason to believe that the relation of the crystallographic axes to the rod is an indication of the manner of the laying down of the calcium salts. Orban,[3] in discussing the laying down of enamel in the dog's teeth, says: "Calcification begins on the whole circumference of the rod simultaneously"; and, in regard to the calcification of human enamel, "Calcification begins at the periphery of each rod and proceeds toward the center. The calcification begins earlier on one

3. Orban, Balint: Dental Histology and Embryology, ed. 1, Chicago: Rogers Printing Company, 1928, pp. 5 and 6.

side than on the other." It is suggested that the acute angle which the c axis of the crystals constituting the rod makes with the long direction of the rod is specifically a function of this eccentric deposition of the calcium salts.

A longitudinal section of a tooth, 40 μ in thickness, in general shows interference colors of a first order, grayish blue or white in the outer portion of the enamel

(Through the darker portion of the enamel there runs a band of "first order white," parallel to the striae of Retzius, which can be explained only as an actual difference in the constitution of the enamel material and not ascribed to any change in rod direction.)

From the bright band at the dentino-enamel junction, dark bands are seen in polarized light extending roughly at right

Fig. 12.—Viewed in ordinary light. Decalcification almost complete. Fine threads of organic matrix are visible. (× 130.)

passing to grayish black in the portion which is separated from the dentin by a very narrow band of white. (Fig. 3*A*.)

Figure 4 shows roughly the distribution of average tooth sections if there is such a thing. *A* is the narrow white band separating the grayish black *B* from the dentin, and *C* is the grayish blue, or white, outer portion of enamel.

angles toward the periphery. On rotating the microscope stage, these areas appear light, and the order of birefringence is close to that for the surrounding enamel. This is not always the case, for sometimes the areas remain dark, and often the birefringence is of a lower color. The explanation of the phenomenon is that there is a change in the direc-

tion of the rods in these areas. Any change in the direction of a rod about a horizontal axis at right angles to the length of the rod would bring about a change in the interference colors. The maximum birefringence is viewed in a position close to a longitudinal section and the minimum when looking down on an end section. A section of a dog's tooth will often have alternating bands of rods in longitudinal and end section. The former give interference colors, while the latter remain dark on rotating the stage.

If a section is placed so that the bands are dark, the upper Nicol is removed and the section viewed in reflected light, the bands described above coincide with what are known as the lines of Schreger. If a section is placed in dilute nitric acid, under crossed Nicols, areas resembling the lines of Schreger appear almost at once where they were previously invisible. In an advanced stage of decalcification, the bands are even more prominent, while the material in between is still normal.

The twisting of the rods in the inner portion of the enamel and their comparative straightness in the outer is well recognized. The continual changing in the direction of the rods would be compensatory in the final effect of birefringence and the interference color is lower than when the rods are horizontal and parallel. It is possible that the white

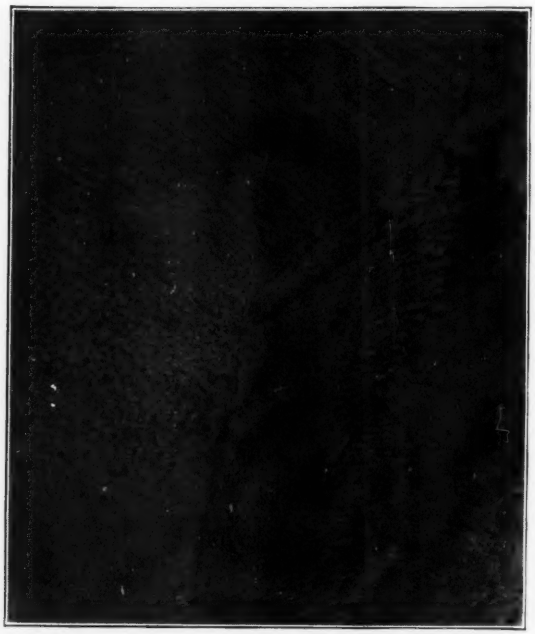

Fig. 13.—Section at area *X* of Figure 12 at higher power in ordinary light. Attention is drawn to the definite rodlike appearance in the lower left portion of the section. (× 480.)

interference color of the band at the dentino-enamel junction is due to the initial straightness of the rods.

A careful examination at a magnification of 350 shows clearly that in these areas of lower birefringence, in which there is no change of direction of the rods in adjoining areas, a constitutional difference is indicated. While the susceptibility of some areas to acid attack may be due to the change in the direction of the rods, it is felt that it is not the whole explanation but that there are differences of composition of the enamel crystals. To anticipate experimental evidence which is given below, the areas giving higher interference colors are constitutionally sounder than those showing the lower colors. Thus, it is suggested that the narrow white band is sounder structurally than the inner portion of the enamel, which is inferior to the outer portion.

In almost every tooth section, there is evidence of two crystal phases which, though possessing exactly the same space lattices as normal enamel, can be differentiated optically from ordinary enamel. These areas are invisible by examination in ordinary light.

Fig. 14.—Section identical with Figure 13, but between crossed Nicols. Note in generally dark field, light area in lower left, showing incomplete decalcification. Also the rod proper is lost, the outer portion alone remaining. (× 480.)

Figure 5 is a view of the section in ordinary light.

Figure 6 is the identical section in polarized light. *A* is normal enamel (to be called negative enamel). It has a low

birefringence. *B* is enamel with yellow interference (to be called positive enamel). *C* is enamel isotropic (to be called isotropic enamel). It will be shown as an intermediate step between *A* and *B*.

The criteria for distinguishing the three phases are given in Table 1.

The difference in birefringence indicates that the indices of refraction, at any rate for one ray, should be different. found in all cases that the yellow, or areas of high birefringence, are separated from the normal by a band of isotropic material. This gradates the change of index so that the differences are not appreciable in ordinary light.

Furthermore, we find that, on decalcifying, the normal enamel is changed into the high birefringent type prior to dissolution of the material, but the isotropic phase always appears between the two.

Fig. 15.—Section of human enamel between crossed Nicols, at a position of maximum light intensity. Attention is directed to dark lines at the rod margins. These dark lines are the organic sheaths of the rods. (× 1,600.)

It is significant that these areas are not visible under ordinary light except in cases in which they are coincident with stain.

It is obvious that the mean indices of refraction are very close, but the birefringence insists on some difference. We The suggestion is made that decalcification removes part of the constitution of the crystal without destroying the general outlines. Let us call the low birefringent material *A*, the high birefringent material *B*, and illustrate what may happen in the enamel. *A* is the composition

of normal enamel; *B*, the composition of positive or high birefringent enamel. The two compositions must be essentially of the same type, as the roentgen ray indicates complete isomorphism.

The ordinate represents the index of refraction. (Fig. 7.) The abscissa represents the change of composition from *A* to *B*.

As something is removed from *A* and finally gives *B*, the lines converge, the birefringence drops until an isotropic condition is reached and progresses on the other side with the position of the lines inverted, giving substance *B* with exactly the opposite sign and sign of elongation.

The production of the areas of high birefringence by decalcification is important and significant, in its chemical as well as its clinical relationships.

TECHNIC OF DECALCIFICATION

Parts of thin tooth sections varying from 20 to 30 m were placed on a 2½ by 2 inch glass slide, and a heavy line of white petroleum jelly was traced on the slide in such a way that it would act as a complete seal for the periphery of a 24 by 50 mm. No. 1 cover glass. Into the container, enough acid celloidin prepared according to Bödecker's[4] directions was poured and the cover glass placed on the rectangle of petroleum jelly and

Fig. 16.—Section as for Figure 14; stage rotated until the rods are just in position of extinction. The white lines at the rod margins are the inorganic outer layers of adjoining rods. (× 1,000.)

4. Bödecker, C. F.: Dental Histology and Embryology, New York: 1926, p. 224.

pressed down onto the section. Any acid celloidin in excess was squeezed out and absorbed into a filter paper touched to the overflow. The petroleum jelly was then dragged with a toothpick over any openings due to overflow of the liquid. In preparations sealed in this fashion, thickening of the celloidin is prevented for a sufficiently long period to decalcify the enamel completely.

By this means, the process may be followed closely, anything except an oil immersion lens being used. Illustrations are given to show the general process.

The tooth section was placed in position and the nitric acid attack commenced. The proceedings were viewed by a mikrosummar, 24 mm. objective.

The tooth was so placed that, with the insertion of the selenite plate and between cross Nicols, the rods on one side (the right) were parallel to the high ray of the plate, and, on the other side, approximately at right angles. Normal enamel on the right (R_1) would appear yellow on the field, and blue on the left (L_1). The occlusal or incisal edge of the enamel dissolves first and more rapidly than the cervical portion, probably owing to the removal of the enamel cuticle by the attrition of mastication. Then the process slows down and a dark black band begins to form. The lines of Schreger which, in the original, are barely visible, after a few minutes attack are very prominent. At first, a dark border forms, which changes eventually to blue (R_2); and in R_3, a blue sawtooth edge of enamel is left, while behind this is a red band separating the blue from the normal "yellow colored enamel." In R_4, in the cervical portion of the section, the blue sawtooth stands out clearly, and the effect produced is due to the solution of the material along the striae of Retzius. The drawings L_1, L_2 and L_3 show the process on the other side of the tooth where the reactions are reversed—blue is normal enamel, and yellow is the positive enamel.

(The large red areas in the pastels are due to the selenite plate reaction, there being no anisotropic material present, except where there is a dash of blue suggesting incomplete decalcification.)

TABLE 1.—CRITERIA FOR DISTINGUISHING THREE PHASES
In a section 30 microns thick

	Normal or Negative Enamel	Positive Enamel	Isotropic
Crossed Nicols	Lavender-gray	Yellow	Black
Birefringence	About 0.003	About 0.006	
Sign	Negative	Positive	
Sign of Elongation	Negative	Positive	

The process of decalcification was followed in another tooth section and photographs are offered in evidence. (Figs. 9-11.) The observations were made under crossed Nicols, but only for one photograph (Fig. 11) was the selenite plate used. In this section, the enamel changed to the isotropic, to the positive stages very rapidly, and, before one-fifth of the enamel was removed, the section had changed over to the positive form.

The stages of decalcification were the same as in the other sections—negative, isotropic and positive. It is apparently impossible to omit the isotropic stage and this, as has been suggested, is the cause of the invisibility of these areas under ordinary light.

Figure 9 shows a view of this material under polarized light. Decalcification has just started at the outside edge of the enamel. Figure 10, under polarized light, shows decalcification advancing apparently along the striae of Retzius and producing a sawtooth appearance. Note here that the material just under the periphery of the enamel has been slower in decalcifying than that farther in, probably owing to the protection afforded by the enamel cuticle. Figure 11 shows the appearance of a partially decalcified section, with polarized light and a selenite plate, which distinguishes the positive from the negative enamel, the former turning blue and the latter yellow. Figure 12, under normal light, shows the decalcification of the enamel, seemingly complete, and the enamel matrix remaining. An examination of the area x (Fig. 12) under a higher magnification and polarized light shows the condition illustrated in Figures 13 and 14. Figure 13, under normal light, shows the apparently decalcified enamel matrix. Viewing the same area under polarized light (Fig. 15), we see that portions of the matrix are not fully decalcified, while the parts that are not birefringent are fully decalcified.

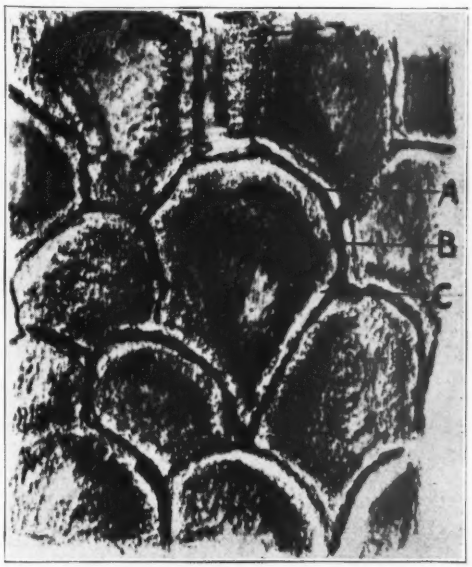

Fig. 17.—Sketch of enamel rods, close to an end section, and seen between crossed Nicols. *A*, organic sheath; *B*, rod proper; *C*, the inorganic outer layer which is differentiated from the rod proper by orientation and probably by constitution.

Positive areas may be produced (1) in the early stages of decalcification and (2) by the heating of powdered enamel for a short period to a dull red heat. Prolonged heating produces an isotropic form which is even a further stage and is not identified with the isotropic enamel described. The effect is therefore a function of the removal of one of the

enamel constituents. If the constituents are considered as to their relative volatility, it is appreciated that tricalcium phosphate can be heated to its melting point at 1600 C. without dissociation, and fluorin can only be evolved at a red heat in a silicious environment (and no silica is present). Mellor[5] quotes Bassett, in referring to hydroxyapatite: "The great difficulty involved in the expulsion of water is taken to indicate that it is directly associated with the acid, rather than the base"; while in carbon dioxid containing apatite, "CO_2 was evolved before the bottom of the crucible was red hot. . . . Carbon dioxide is not present as a calcium or magnesium carbonate but rather as a phosphato-carbonate or a carbonato-phosphate."

On the other hand, the solution of the two types of enamel in hydrochloric acid and the passing of the gases evolved into a saturated solution of barium hydroxid, as a qualitative test did not indicate from the quantity of barium carbonate precipitated that very much carbon dioxid had been removed on heating. It is probable that equilibrium is such that the amount of carbon dioxid present is critical and that a slight disturbance of the concentration is productive of a profound effect in the optical,

Fig. 18.—Keratinous material, a human nail, viewed between crossed Nicols. Birefringence is manifest. (× 130.)

5. Mellor: Comprehensive Treatise on Inorganic and Theoretical Chemistry, Vol. 3, p. 904.

and possibly the physical, properties of enamel.

There is a field for physical chemical research to establish more completely the solid solution effects of calcium fluorid, calcium hydroxid and calcium carbonate in tricalcium phosphate. The correlation of such data with the optical properties of the crystalline material of the enamel would be a great advance in the understanding of the composition of tooth tissues; and possibly the dietary deficiencies as manifested in the hard tissues of the tooth might be more clearly known. Work is already in hand to attempt to correlate the changes found in the enamel with changes of diet in rodents. A complete statement as to the exact chemical changes taking place is essential. The technic, using polarized light, merely differentiates the phases.

From the evidence, it would seem reasonable to say that the isotropic and the positive areas are stages in decalcification and represent the removal of a certain component, or components, from the normal enamel. Without being able to state the answer to the chemical problem fully, the phenomenon is explained as a remarkable case of solid solution and the change from *A* to *B* in Figure 3 represents the change in concentration of the solid solution. There are numerous cases in mineralogy of a change in sign

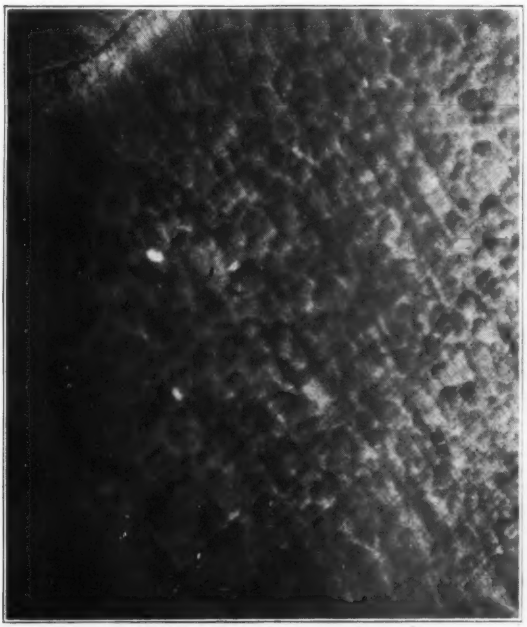

Fig. 19.—Human dentin viewed between crossed Nicols. Under the dentino-enamel junction is a band appearing light. There is a rapid darkening and the appearance of "semilunar" areas, thought to contain inorganic salts. (× 130.)

due to solid solution effects. The tricalcium phosphate minerals vary considerably in composition, as to both the elements present and their concentrations, without changing the space lattice. The following compositions are isomorphous: $3Ca_3(PO_4)_2\ CaF_2$, $3Ca_3(PO_4)_2\ CaCl_2$, $3Ca_3(PO_4)_2\ CaCO_3$, $3Ca_3(PO_4)_2\ Ca(OH)_2$. An example of the effect of solid solutions in changing the optical properties without altering the space lattice is the relation of fluorapatite to chlorapatite. The addition of 13, 45 and 74 per cent of the latter to the former gives the following indices of refraction: 1.630, 1.649, and 1.658.

In the case of the enamel, the negative crystal with what we have described as a "first order white" interference color represents the most complete form. As the removal of a constituent, or, as we have assumed, the carbon dioxid, takes place, the birefringence falls, blue-gray, lavender-gray, iron-gray to zero and then begins to increase with a change in sign. From this, it is realized that there is probably a great variety of composition in the makeup of the enamel. It indicates critical conditions and the effect on enamel structure of what may be regarded as minor constituents.

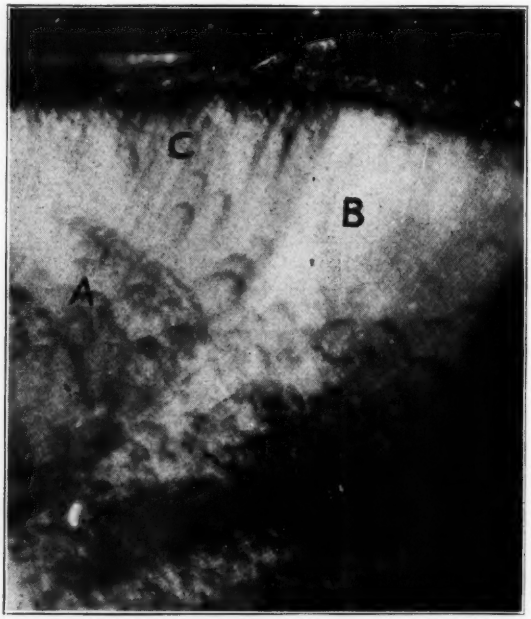

Fig. 20.—Identical sections between crossed Nicols prior to decalcification. In this figure and Figure 21, *A* shows semilunar areas which lose their distinctive outline on decalcification. *B*, affected dentin unaltered by decalcification. *C*, normal dentin becoming more luminous after decalcification. (× 130.)

Therefore, the presence of isotropic or positive areas in a tooth section indicates the deficiency, to an important degree, of some constituent and might possibly suggest some metabolic disturbance during tooth formation. This is illustrated in the striae of Retzius. Furthermore, there may be some relationship between this deficiency and susceptibility to caries, and with this in view about 100 sections, ranging from the deciduous to the senile, were examined. In general, it was found that deciduous and adolescent teeth were peculiar in the large quantities of positive areas found, and those from patients approaching senility were singularly free. It is advisable to call attention to the fact that such a study taken from clinical evidence may be unsound, for the normal condition of teeth in human beings is not being considered, but only the pathologic. In the young, the teeth are extracted for caries; while, in the old adult, extractions are often made of noncarious and pyorrheic teeth, and healthy teeth are removed in preparation for full dentures.

Furthermore, the study of a hundred teeth is not comprehensive. The amount of deciduous enamel is relatively small and one section is a small portion of any tooth. Deciduous teeth may be found without any positive areas and the senile with them. In such work as this, the evidence of a hundred observers is required, for only an enormous quantity of

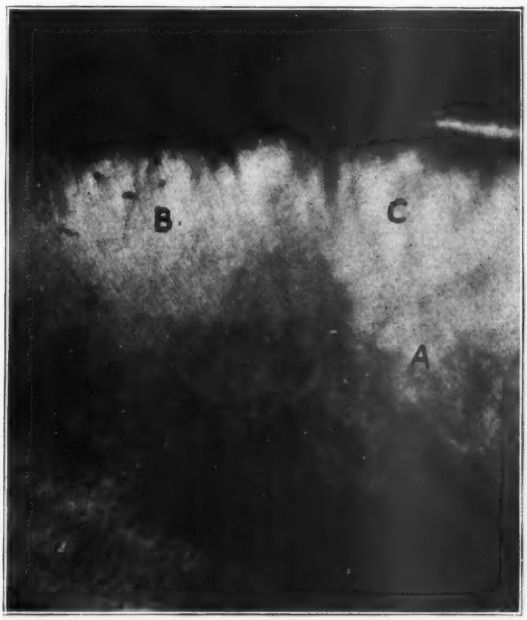

Fig. 21.—Human dentin shown in Figure 20; after decalcification. (The section was inadvertently turned over.) (× 130.)

accumulated evidence has any significance.

If histologists are interested in this technic and observations are made, we would point out that Canada balsam has a decidedly decalcifying action and sections prepared should be mounted in cedar oil.

Sections quite free from positive areas mounted in Canada balsam were found to contain them after a short period.

Fig. 22.—Human dentin section between crossed Nicols. The affected area stands out markedly. Note lack of semilunar areas in bright portion. (× 130.)

COLLECTION OF MATERIALS AND PREPARATION OF SECTIONS

Through the cooperation of D. P. Snyder, in charge of the exodontia work in Ohio State University, School of Dentistry, and members of his staff, extracted teeth and data pertaining to each patient contributing to this material have been collected. The data, as complete as possible in each case, were as follows:

Project 5c Case No. Date
Age
Sex (If female, number of children)
Color
General health
Number of teeth removed
Number of teeth remaining
Reason for extraction
Condition of mouth
Type of dental service in evidence
History of any serious illness and approximate date
Remarks:

The teeth, immediately after extraction, were washed in water to remove blood and attached débris and placed in labeled bottles

containing warm water. On being delivered to the research laboratory, they were washed again and placed in approximately 50 per cent alcohol to await grinding. This was done on a Black type grinding apparatus capable of adjustment to 6 μ. One longitudinal section was ground from each specimen in a mesiodistal direction, to include contact points wherever possible. Sections were mounted on slides 1½ by 1 inch to facilitate examination on a revolving microscope stage and in ordinary cedar immersion oil. This mounting medium was chosen because it seems to produce no change due to decalcification in the enamel, and, after several weeks, hardens around the margin, giving a reasonably stable condition. Specimens were laid flat and, after several weeks, the cover glasses are tight enough to enable the removal of immersion oil from their surfaces without disturbing the section.

An interesting occurrence of positive areas is found in teeth containing cavities. The section is ground past the cavity, its bare outlines being visible in ordinary light. Close to the outlines of the cavity are found, between crossed Nicols, stringers of positive enamel (Fig. 3). In most cases the sharp white band in the enamel along the dentino-enamel junction is unbroken, acting as if it were a barrier to attack. In such cases, the dentin is invariably normal. There are no marked disturbances. Figure 3 shows the positive area breaking through the white band into the dentin. The dentin at this point is abnormal. It is clear and has a higher birefringence.

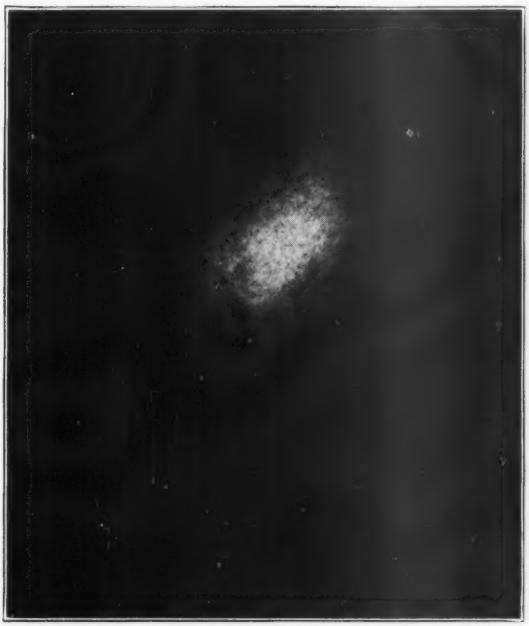

Fig. 23.—Section shown in Figure 22, after decalcification. The area is still double-refracting and is more luminous than the surrounding areas. (× 130.)

These stringers of positive enamel may have some relation to the "zones of carious degeneration" described by C. F. and H. W. C. Bödecker.[6] But it is important to bear in mind that these changes in the enamel which we have obtained may be reproduced by purely chemical or physical means, where no bacterial action could possibly be involved.

Histologists have found that there are three components of the enamel: (1) the rods, (2) a cement-like, or interprismatic, substance and, according to some, (3) the rod sheath, or organic material. The evidence from this work as to 1 and 3 is substantiated, but the interprismatic substance offers certain difficulties.

If a section one rod in thickness is examined, owing to the low birefringence it is difficult to resolve the rod from the surrounding material. If the section is thick enough to give relatively strong birefringence, the apparent appearance of interprismatic material may be due to underlying rods which have a different orientation.

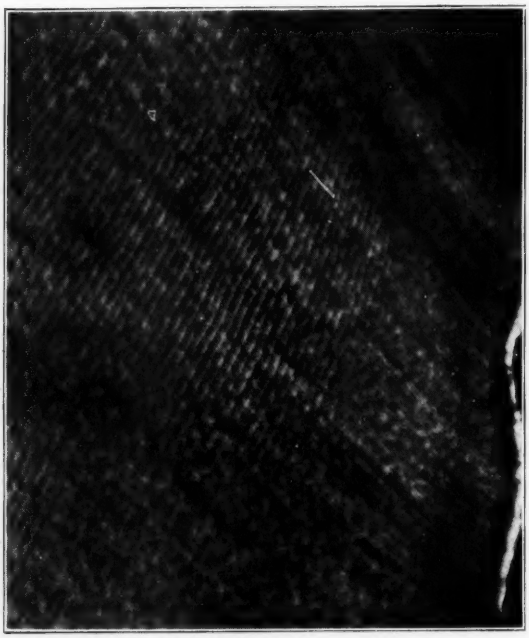

Fig. 24.—Coronal portion of dentin with pulp cavity at lower edge of plate. Viewed between crossed Nicols, section shows dentinal striae, alternating dark and light. (× 130.)

The examination of several sections leads to the belief that there exists an inorganic substance surrounding and yet separate and distinct from the rods. Looking at the rods in longitudinal section between crossed Nicols and at a position, say, of maximum light intensity,

6. Bödecker, C. F., and H. W. C.: Bacterial Destruction of Dental Enamel, J. Dent. Res., 9:37-53 (Feb.) 1929.

the rods are seen to be separated from each other by a dark line.

The stage is then rotated until complete extinction is about to take place, when, at the margins of the rods, a light streak appears which is not completely extinguished when the main rod material is extinguished. (Fig. 16.)

The interference color of this interstitial substance is usually white, while the rods themselves are grayish blue. If the theory we have attempted to establish, that negative enamel giving a white interference color is sounder constitutionally than the material giving lower interference color, is true, this inorganic sheath around the rod is less susceptible to attack. There is evidence for this from experiments in which thin sections of enamel have been decalcified over a long period—say, twenty-four hours. The outside of the rod is often the last part to disappear. (Fig. 14.)

The organic matrix is described here as the isotropic portion of a rod when viewed in longitudinal section. If the rod is viewed in end section (Fig. 17), the main mass of the rod *B* is dark, separated from contiguous rods by a material *C* giving a distinct interference color. Using a magnification of 1,000 diameters, in these light areas may be seen the distinct black lines shown in Figure 17 at *A*. These are portions of the organic matrix. The examination of the organic matrix after complete decalcification shows that it is isotropic.

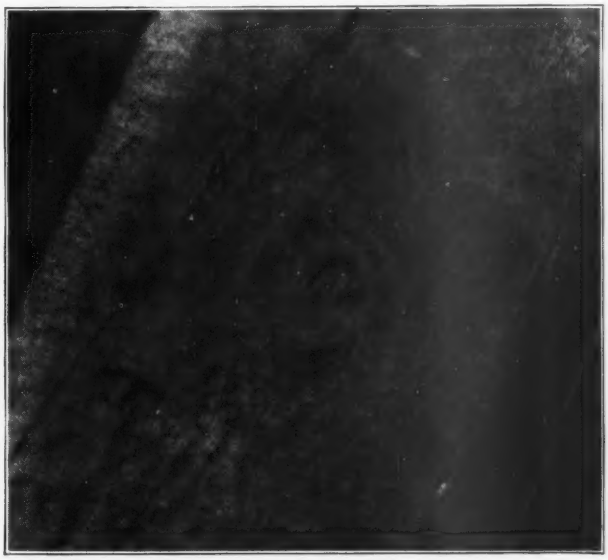

Fig. 25.—Root dentin under polarized light and between crossed Nicols; prominent striae in the radicular dentin at *AA;* cementum at extreme left showing alternate light and dark layers. (× 130.)

We would call attention to Figure 18, a photograph of some keratin (scraping of human nail) seen in polarized light.

The keratin was placed in 5 per cent nitric acid for a period of time sufficient to decalcify a thin section of human tooth, both dentin and enamel. The birefringence of this keratin is very evident. Using this property of birefringence as a criterion for determing the presence of keratin, we have been unable to find any trace of that material in the organic matrix of enamel. The secondary cuticle of the enamel, which is a product of the stratified squamous epithelium, is definitely birefringent. (Fig. 9.)

C. F. and H. W. C. Bödecker[7] make the following statement regarding the composition of the organic portion of the enamel. "The selectivity shown by the proteolytic bacteria in destroying the content of the enamel rod more quickly than the enclosing enamel rod sheath suggests that these two structures differ chemically. The authors believe the sheath is composed of keratin and the rod proper of calcified protoplasm (albumin, albumin-like material)."

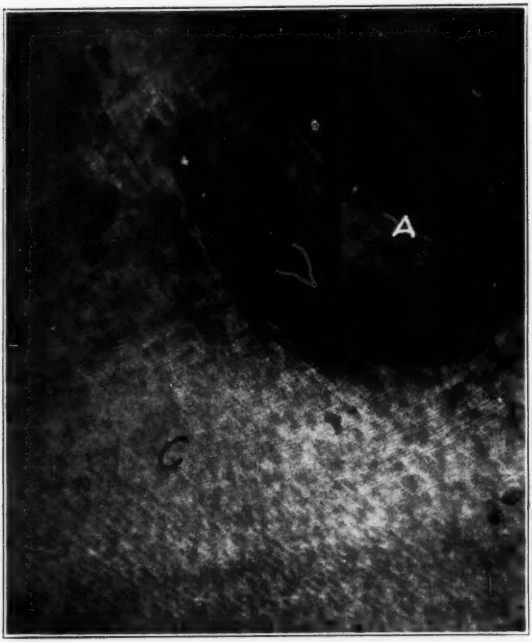

Fig. 26.—Polarized light, shows a section with decay pentrating the dentin at the base of an occlusal pit and the splitting away (*A*) of the soft leathery dentin occurring along one of the so-called striae of Mummery.

E. W. Fish[8] in a discussion of the enamel says: "The most striking feature of these observations is that one is drawn

7. Footnote 6, p. 52.

8. Fish, E. W.: Physiological Survey of the Nature of Enamel in Carnivora and Primates.

to the conclusion that the prism sheaths, lamellae and also the enamel cuticle are physiologically continuous and similar in composition, and since the cuticle is known to be keratinous there appears to be little alternative to assuming that the lamellae and the prism sheaths are of a similar nature."

On the other side of the discussion, Orban[9] says: "Gottlieb states that not only one, but two enamel cuticles exist. The inner layer which we call the primary cuticle is built by the ganoblast. It is an organic membrane and may become calcified. This membrane is not a keratinous substance and is no more resistant to acids and alkalis than is the organic matrix of the enamel or the enamel itself. But there is another cuticle outside of the primary cuticle which is built during the process of tooth eruption by the stratified squamous epithelium of the epithelial attachment and is called 'secondary enamel cuticle.' This cuticle, by reason of its origin, is a keratinous substance and is resistant to acids and alkalis. It may be from 2 to 10 micra in thickness."

Fig. 27.—Dentin in normal light, showing splitting away of leathery decay (*D*) along striae (*A*); interglobular spaces at *B;* healthy dentin at *C.* (× 130.)

The keratinous area (secondary cuticle) can be seen in Figure 10 and the lack of birefringence in the enamel matrix below it indicates that the matrix is not keratin. Furthermore, a comparison of Figure 13 (organic matrix of enamel under normal light) and Figure 14 (the

9. Footnote 3, pp. 114-115.

same area viewed under polarized light and between crossed Nicols) shows none of the birefringence of keratin, where calcification has been complete.

Our findings on the composition of the secondary enamel cuticle place us in agreement with Gottlieb and Orban regarding the presence of keratin.

If the matrix of the enamel is keratin, it is evident that we must consider it as a different type of keratin from any other that we have examined.

There is a phenomenon which at present seems to have no particular significance. In Figure 6, a photograph taken with polarized light, strong white lines are seen running from the negative enamel into the positive and out into the negative on the other side. These lines seem to be spaced uniformly apart—perhaps 5 or 6 rods in thickness—and follow roughly parallel paths. Figure 2 illustrates the same phenomenon. In this case, the section is devoid of any positive areas.

THE DENTIN

The calcium salts held in some invisible form in the dentin have exactly the same space lattice as the crystalline material of the enamel. It is hardly to be expected that the marked difference of refractive index between enamel (1.62) and dentin (1.56) can be accounted for in terms of a difference of 0.06 in the

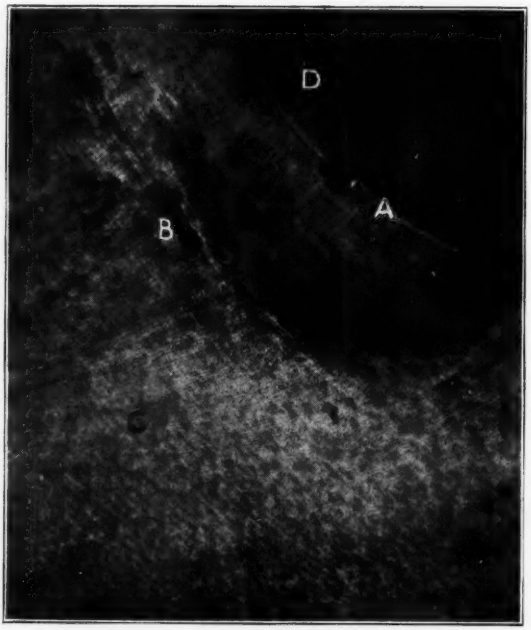

Fig. 28.—Section shown in Figure 27 in polarized light and between crossed Nicols, showing coincidence of interglobular spaces and semilunar areas at *B*, and visibility of latter at *C*. (× 130.)

indices of refraction of their respective inorganic salts. The incineration of powdered dentin gives isotropic grains whose index of refraction is close to 1.62. If the salts are present in the dentin in the crystal form, they would be visible by microscopic examination. No such crystals are visible, and it is assumed that the inorganic substance is held in a colloidal form in an organic matrix, and the index of refraction is mainly that of the organic substance. Though the inorganic crystals are invisible, they produce an effect of birefringence, indicated by the increase of birefringence of the dentin on decalcification. The phenomenon of birefringence in colloids is well known. If a colloidal solution of ferric hydroxid is passed down a small capillary tube placed on the microscope stage, and observed in polarized light and between crossed Nicols, marked interference colors are seen. We recognize the preferential orientation of the crystals in the enamel, and it is probable that the colloidal particles are preferentially orientated in the dentin. If, therefore, they produce an effect of birefringence, such a birefringence must be either additive or subtractive to the birefringence of the organic material. If a piece of dentin is placed in dilute nitric acid, the birefringence increases gradually, commencing from the outside edges, if the specimen is held under a cover glass. After complete decalcification (which is assured by spectroscopic analysis),[10] the section is more uniformly birefringent and the color is of a higher order.

A uniformly thin section of dentin varies considerably from one part to another in the interference colors manifested. (We wish to use the phrase "luminously birefringent," as it conveys what is observed much more accurately.) The mesial portion of the apical third is the most luminously birefringent portion of the dentin and extends from the edge of the cementum close to the pulp. This degree of luminosity decreases slightly in the apical portion of the dentin. Toward the coronal portion of the tooth, there is a luminous narrow band immediately under the enamel. The luminosity of this band is not due to the superposition

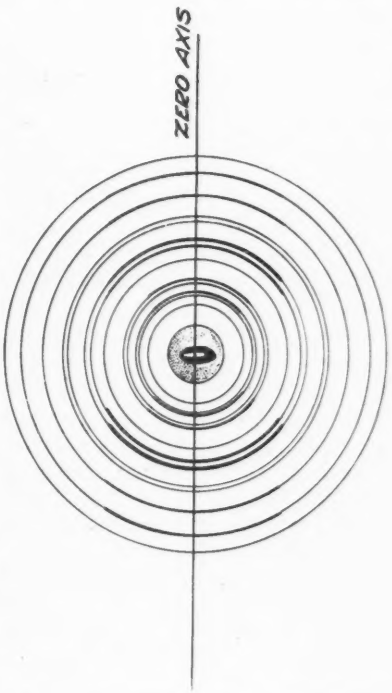

Fig. 29.—Diagram of rotating crystal roentgen-ray photograph (enamel). The presence of circles suggests heterogeneous orientation of crystals of enamel, but marked intensity of the lines along the zero axis indicates preferential orientation in one direction.

10. We are greatly indebted for this determination to Dr. Marion Hollingsworth of the Department of Chemistry, Ohio State University.

of dentin over enamel. There is a rapid darkening toward the pulp. The coronal portion of the dentin is on the whole darker than the other portions. Figure 19 shows a coronal portion of dentin. A small luminous band appears under the dentino-enamel junction, the remainder appearing darker.

Distributed over the section, commencing just under the luminous band, are what we will call the "semilunar areas." These areas are isotropic. They are distinctly outlined and, in many cases, coincide with the so-called interglobular spaces. This particular section was preserved for demonstration purposes. Figure 20 is a photograph of a section prior to decalcification showing the semilunar areas (*A*), an affected area of dentin (*B*) and a darker or normal portion (*C*).

Figure 21 is the same section after decalcification. (It was turned over by mistake, but this in no way affects the conclusions as to birefringence.) The difficulty of obtaining comparable light values in both photographs may confuse the evidence, but if the light and dark areas in Figure 20 are compared with the same areas in Figure 21, and it is realized that the light area changes but little on decalcification, it is evident that *C* has become much more luminous and the sharpness of the semilunar areas of the first photograph gives place to the "amorphous" dark places of the decalcified section. From this evidence, it appears that besides a general distribution of the calcium salts in the organic matrix, they also occur as accretions, resembling closely the interglobular spaces visible in ordinary light.

In the section of this paper on enamel, it was pointed out that if the areas of decay, outlined by stringers of positive enamel, break through the thin white band protecting the dentino-enamel junction, the dentin is often affected. Figure 3 illustrates this phenomenon. Where a dark line crosses from the enamel to the dentin, there is an isotropic area, appearing in ordinary light as a yellow stain, in the dentin, surrounded by a luminous area which merges into the normal dentin. This luminous portion is free from semilunar areas. If a similar section is decalcified, the heavily stained isotropic area (*B*) becomes birefringent, still preserving the yellow stain. The theory is advanced that *B* is due to the accumulation of calcium salts drawn from the surrounding dentin, which accounts for the luminous appearance of *C*, as a defense mechanism.

This theory has not, of course, been fully established, but it is offered as an indication of the possibilities of the technic in elucidating the problem of the distribution of the inorganic salts in the dentin, and changes that may take place under the influence of irritation. There must also be taken into consideration the fact that the birefringence of the organic material of the dentin changes and that there is evidence that irritation may produce changes in the organic crystals. Figure 22 is an example of an area in the dentin just under the enamel, free from any semilunar areas, unstained and without the isotropic center seen in Figure 3.

On decalcification, this bright area remains intact and, in Figure 23, the same area is photographed, showing its birefringence and the relative lack of birefringence in the surrounding material, even after the calcium salts have been completely removed. It is tentatively suggested that the crystalline phenomenon in the organic material of the dentin is far more significant than has hitherto been suggested in the rela-

tion of the tooth structure to immunity from caries.

An illustration of organic crystallization is found in what are called by Mummery[11] the striae or areas of lamination or stratification of the dentin. He says:

> In completed dentine the striae are hidden by the dense calcification . . . occasionally revealed in caries by the action of the bacterial acid product upon the matrix . . . that this lamination or stratification of the dentine is due to the structure of the calcospheritesis, we think, very evident and is the result of the rhythmic or periodic deposit of the lime salts in the colloid.

11. Mummery, J. H.: Microscopic and General Anatomy of the Teeth, London: Oxford University Press, 1924, pp. 280-281.

The dentinal striae of Mummery are shown in polarized light in Figure 24 as narrow alternating bands in the coronal portion and in Figure 25 in marked strong lines spaced somewhat apart in the mesial portion of the root dentin. Decalcifying such a section does not change the appearance of these lines and examination shows them as alternating isotropic and double refracting bands of material. Their existence is apparently not a function of any periodic deposition of inorganic salts.

Figure 26, polarized light, shows a section with decay penetrating the dentin at the base of an occlusal pit, and the

TABLE 2.—ROENTGEN-RAY SPECTRA DATA*

Line	Intensity	Apatite	Adult-Enamel (1)	Adult-Enamel (2)	Positive Enamel	Incinerated Enamel	Deciduous Dentin
		(d)	(d)	(d)	(d)	(d)	(d)
1	S	3.42	3.44	3.43	3.42	3.43	3.42
2	W	3.17	....	....	....	....	....
3	W	3.07	....	....	....	....	....
4	S	2.78	2.80	2.81	2.80	2.81	2.79
5	S	2.69	2.72	2.71	2.71	2.68	....
6	M	2.62	2.64	2.61	2.62	2.63	....
7	..	....	2.68	2.52	....	....	....
8	S	2.25	2.27	2.27	2.25	2.26	....
9	W	2.13	....	2.15	....	....	....
10	W	2.06	....	2.05	....	....	....
11	S	1.93	1.95	1.94	1.94	1.94	1.94
12	M	1.88	1.89	1.89	1.88	1.89	....
13	S	1.84	1.84	1.84	1.84	1.84	1.84
14	W	1.80	....	....	....	....	....
15	W	1.77	....	....	....	....	....
16	W	1.74	....	....	....	....	....
17	W	1.72	1.72	1.72	1.72	1.72	1.72
18	W	1.64	....	....	....	....	....
19	W	1.53	....	1.54	....	....	....
20	W	1.50	....	1.50	....	....	....
21	W	1.47	....	....	....	....	....
22	W	1.45	....	1.45	....	....	....
23	W	1.42	....	....	....	....	....
24	..	....	....	1.32	....	....	....
25	..	....	....	1.11	....	....	....

*Not all the lines found are given, only those which are measurable. All the lines are present in the various materials and their coincidence was established by direct comparison.
S = Strong; M = Medium; W=Weak.

splitting away (*A*) of the soft leathery dentin is occurring along one of the so-called striae of Mummery. This is an interesting example of petrographic technic revealing phenomena which are only seen by ordinary light methods in abnormal cases.

Figure 28 at *B* we see the same phenomenon as at *B* in the previous plate. The interglobular spaces are apparent in both cases, but with the section seen in polarized light the semilunar areas are visible, say at *C*, where no such discontinuities can be observed in ordinary light.

THE CEMENTUM

However important the cementum may be as a tooth tissue, and we recognize this importance, it was found necessary to leave the investigation of this tissue to the last and few data are forthcoming. We hope to be able to report more fully at a later date. It will suffice for the present to state that the primary cementum is laid down in bands parallel to the axis of the tooth, the bands being alternating, birefringent and isotropic, and, in some cases, the bands are differentiated by a difference of crystal orientation. The secondary cementum is birefringent, but is not laid down in such a definite manner.

ROENTGEN-RAY SPECTRA DATA ON INORGANIC CRYSTALS OF ENAMEL AND DENTIN

Dr. F. C. Blake, professor of physics, Ohio State University, kindly consented to undertake an investigation of the lattice structure of the inorganic crystals of the enamel and dentin.

There has been insufficient time for Dr. Blake to make a complete report, but he has generously permitted us to publish the results of part of his work in establishing the isomorphism of the dentin and the enamel with the mineral apatite. The evidence is conclusive and we are assured of the hexagonal nature of the crystals in the dentin and enamel. The histologic and chemical significance is referred to in the text.

An attempt was made to find directly the space lattice of enamel by a rotating crystal roentgen-ray photograph. Owing to the extreme difficulty of printing such a photograph, a diagram (Fig. 29) is presented, giving the positions of the circles and their relative intensity. The section was rotated about the long axis of the rod. If the section had consisted of one single crystal, a series of regularly arranged spots would have appeared. The presence of circles on the film indicates the heterogeneous orientation of the crystals in the enamel, but the marked intensity of the portions of circles along the zero axis is evidence, at any rate, of preferential orientation in one direction.

Powder roentgen-ray photographs were then made using periclase (MgO) as a standard for determining the radii of the film. From these films, the distances, between the atomic layers, were calculated, and the agreement of these values (*d*) for all the crystalline materials is a proof of their isomorphism.

We are grateful to Dr. Blake for his work and interest in our problem and trust that he will shortly publish the complete analysis.

SUMMARY

Enamel.—1. The enamel is composed of a double refracting crystalline substance possessing a low birefringence (about 0.004).

2. The crystals are isomorphous with the mineral apatite and are therefore in the hexagonal system.

3. The c crystallographic axis is inclined at an acute angle to the long direc-

tion of the rod. This is suggested as confirming Orban's view as to the eccentric deposition of human enamel.

4. In canine enamel, the c crystallographic axis is parallel to the long direction of the rod. This also agrees with Orban's view as to the formation of the rod in canine enamel.

5. Three types of enamel are described: (*a*) normal or negative enamel: (*b*) isotropic enamel, and (*c*) positive enamel; "high" birefringence.

6. The changes from one type of enamel to another appear to be a function of some easily removable constituent, probably carbon dioxid.

7. The changes from negative to isotropic to positive enamel is not abrupt but represents the critical phases in what is in reality a gradual change in a solid solution series.

8. An attempt is made to recognize differences in constitution in negative enamel by the order of birefringence. "The first order white" seems to be less susceptible to attack by acid.

9. The artificial production of the isotropic and the positive enamel is effected by decalcifying agents and heat.

10. The process of decalcification is described and completely and incompletely decalcified organic matrix are photographed. The criterion of birefringence is used in determining decalcification.

11. The organic matrix is shown to be either a new type of keratin or not keratin at all, while the secondary cuticle is definitely keratinous. The last agrees with the view of Gottlieb and Orban. The first statement is contrary to opinions held by Bödecker and Fish.

12. The rod proper is enclosed in a layer of inorganic material separated from other rods by the organic sheath. This is in contradiction to the usual view.

13. The material comprising the inorganic sheath is regarded as being similar to the material of the rod proper. It is oriented in a different direction, and is conjectured to be constitutionally different, if only slightly, and is less susceptible to decomposition by acids. We associate it with the material described as the "first order white."

The Dentin.—1. The inorganic crystal of the dentin is exactly isomorphous with that of the enamel.

2. The invisibility of the inorganic substance and the low index of refraction of the dentin indicate the colloidal nature of the inorganic substance.

3. The organic material of the dentin is crystalline and double refracting.

4. The inorganic substance is compensatory in the general effect of the birefringence of the dentin. Decalcified dentin is more luminously birefringent.

5. The inorganic salts are distributed partly in a uniform manner in the organic matrix and partly in aggregations visible only under polarized light but in some cases coincident with the interglobular spaces of the dentin. We have called these the "semilunar areas."

6. Dentin affected by irritation has a peculiarly luminous birefringence, which, it is thought, may be attributed to two conditions: (*a*) the removal of the inorganic substance from the particular area, and (*b*) a marked increase in the birefringence of the organic material.

It is possible that this increase in birefringence may function as part of a defense mechanism against caries.

7. The striae of the dentin, described by Mummery as seen usually only in decalcifying areas, are plainly visible in polarized light in all parts of the section. Their alternating birefringent and isotropic character is described

SETTING UP THE FULL DENTURE; PRODUCING A BALANCED ARTICULATION*

By ROBERT R. GILLIS, D.D.S., Hammond, Ind.

IT is assumed that the casts with bite-plates are already mounted on the articulator; that the articulator is adjusted for the case in hand; that all preliminary data have been secured, and that we are now about to set up the twenty-eight teeth of the full upper and lower denture.

No consideration of esthetics will occupy this discussion. Esthetics will determine the positions of the anterior teeth but will have practically no consideration in positioning the posteriors. This is indeed fortunate for the prosthetist, for it leaves him free to heed only the mechanical requirements in what seems to us the most vital part of the setting up. Esthetics will usually find ample expression in the maxillary anterior teeth, thus leaving us free to position the mandibular anteriors compatibly with the mechanics of the case without sacrificing the esthetics. In any case in which esthetics must compromise with mechanics, we deem it best to sacrifice esthetics; for such a condition probably will be found associated with an abnormality wherewith physical comfort and efficiency far outweigh appearance.

The mechanical requirements are satisfied, in the main, in the positional relations of the posterior teeth.

The "laws of articulation" have never been so concisely expressed as by Hanau. In his quint (Fig. 1), he shows the interrelations between five factors which enter into consideration in setting up a full denture. While each of these five factors is important in every case, we would make an effort at simplification by always mounting the case so that the plane of orientation will be parallel with the jaws of the articulator, thus neutralizing this factor as far as possible.

The interrelation of the other four factors with which we deal in this presentation may be graphically illustrated by two cable towers and a pier supporting a cable (Fig. 2). Let *A* represent incisal guidance; *B*, cusp height; *C*, condylar guidance, and *DFD*, a compensating curve. Variation of the height of either tower or of the pier brings a resultant change in the position of the cable. As the position of the cable is dependent on the heights of its supporting towers, so the compensating curve of our tooth alinement is dependent on the interrelation of the three active factors, condylar guidance, cusp height and incisal guidance.

So, in setting up a full denture, we find ourselves dealing with three major active factors and their resultant. This manner of approaching the problem reduces it to its simplest terms and may bring a clearer understanding to some of our profession who have been confused in the past.

Most dentures are set up more or less "by rule of thumb"; most dentists do not

*Read before the Section on Full Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1929.

understand *why* certain requirements of articulation must be met and still fewer know *how* to meet these requirements and produce a balanced articulation.

Our present effort shall be to explain a method detailing *how* balanced articulation can be accomplished in setting up a full denture.

Figure 3 shows the ensemble of bite-plates, casts and adjusted articulator. Parenthetically, we call attention to certain markings on the maxillary cast: (*a*) Approximately in the sagittal plane is an indication for the median line of the

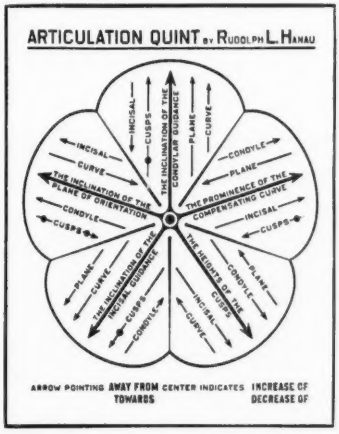

Fig. 1.—Hanau's quint; showing interrelation of five factors.

maxillary denture. (*b*) The figures appearing as a fraction indicate, by the upper one, the distance between the incisal pin and the labio-incisal edge of the bite-plate (Fig. 4) and, by the lower one, the distance between the lower edge of the maxillary articulator member and the labio-incisal edge of the bite-plate (Fig. 5). These figures serve as additional guides in setting the maxillary central incisors. (This is a guide for the central incisors only.)

(*c*) Near the cuspid eminence (Fig. 4), a line has been produced from a scratch on the bite-plate which indicates the corner of the mouth; hence, the position of the cuspid. (*d*) The 30 in a right angle tells us that Stenson's duct is 30 mm. below that intersection and becomes our faithful guide for the location of the mesiobuccal cusp of the maxillary second molar. I would suggest that you carefully examine your next hundred adult patients presenting fairly normal natural dentures and discover the very constant relation between Stenson's duct and the second molar. This duct is likewise our guide for height of the occlusal surface of the maxillary bite-plate.

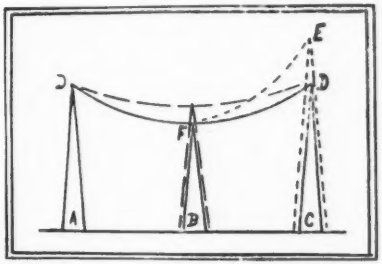

Fig. 2.—Author's graphic interpretation of the relation between incisal guidance, condylar guidance, cusp height and compensating curve.

We are ready to proceed with placing the teeth.

The actual setting up of the teeth may be divided into six progressive steps:

STEP ONE

Figure 6 shows the ensemble of the maxillary anterior teeth. The incisors and cuspids have been so placed as to meet the measured requirements of the fraction-figure, the median and cuspid indicators and the contour of the mandibular bite-plate (Figs. 7-8). Many variable relations of these six teeth, as re-

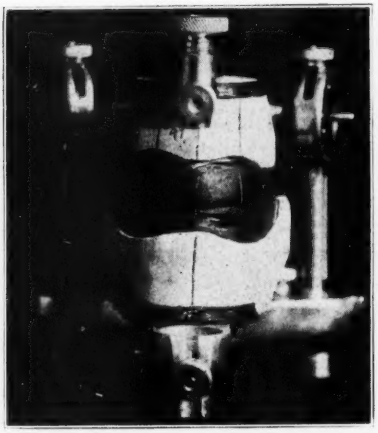

Fig. 3.—Ensemble of biteplates, casts and adjusted articulator.

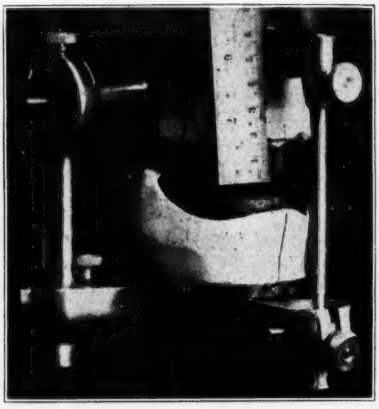

Fig. 5.—Denominator of fraction registering distance between maxillary bar and labioincisal of biteplate.

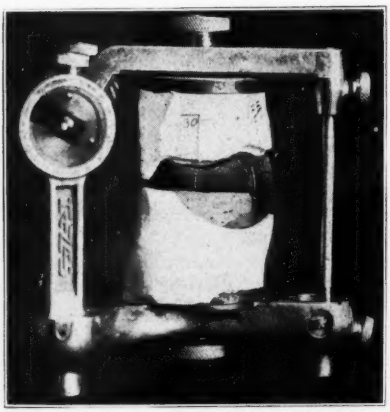

Fig. 4.—Numerator of fraction registering distance between incisal pin and labioincisal of biteplate.

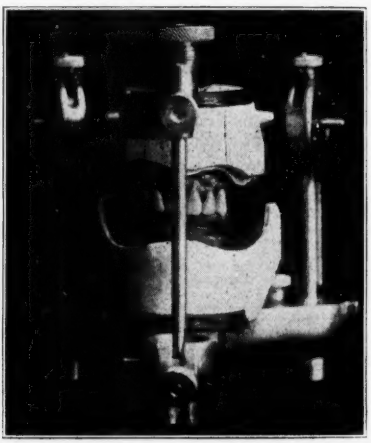

Fig. 6.—Maxillary anterior teeth meeting esthetic requirements.

quired by esthetics, may be employed and all be compatible with the positional limits mentioned.

STEP TWO

With the six maxillary anterior teeth in place, we next modify the occlusal contour of the mandibular bite-plate posteriorly from the cuspid position, carving it (Fig. 9) according to the indicated condylar guidance, incisal requirements and cusp height selected for the case, to create a prospective compensating curve. Remembering that the compensating

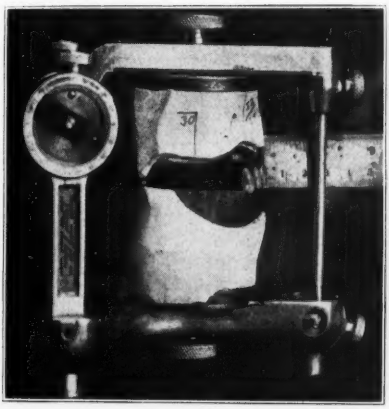

Fig. 7.—Maxillary central incisors in relation to incisal pin as per fraction of Figure 4.

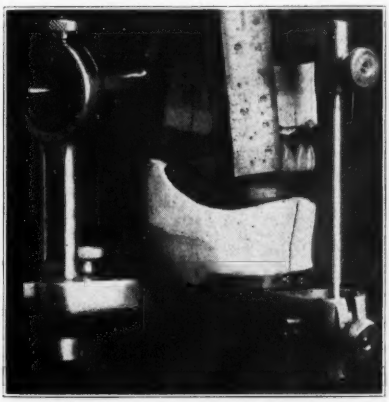

Fig. 8.—Maxillary central incisor in relation to maxillary bar as per fraction in Figure 5.

curve will be the resultant of the three major active factors just named, the beginner with this method will consult the laws of articulation as expressed in Hanau's quint; but experience will soon dictate the required contours. Figure 9 shows the modification for the present

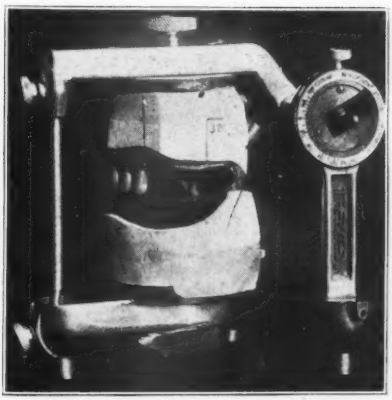

Fig. 9.—Mandibular biteplate carved in bicuspid and molar region to create a prospective compensating curve, dictated by laws of articulation.

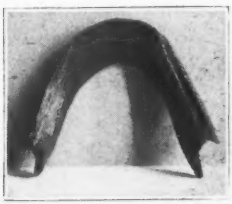

Fig. 10.—Guide lines for setting of maxillary bicuspids and molars.

case. Next, a pair of guide lines (Fig. 10) are scratched on the occlusal surface of this modified mandibular bite-plate straight from the distal ridge crest to the distolingual angle of the cuspid. This line serves temporarily as the location for the buccal cusps of the mandibular posterior teeth.

The maxillary bicuspids and first molars are now placed so that their buccal cusps bear the same relation to the buccoclusal margin of the mandibular bite-plate as the corresponding margin of the maxillary bite-plate did earlier, their lingual cusps making contact with its occlusal surface, and their mesiodistal

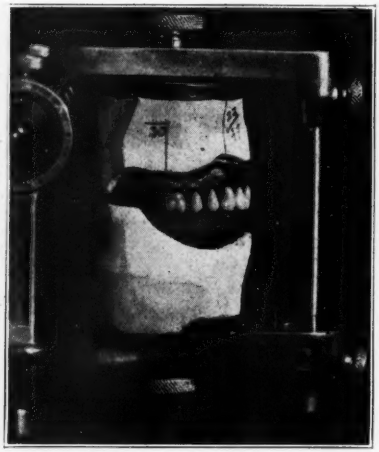

Fig. 11.—Maxillary first molar and bicuspids set to mandibular biteplate.

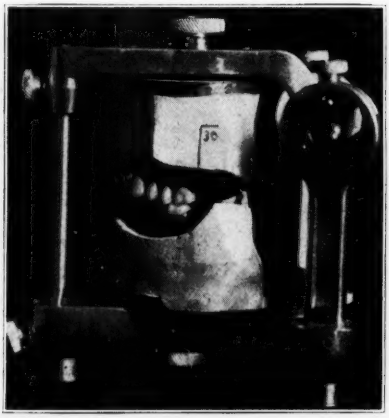

Fig. 13.—Working position of left molars.

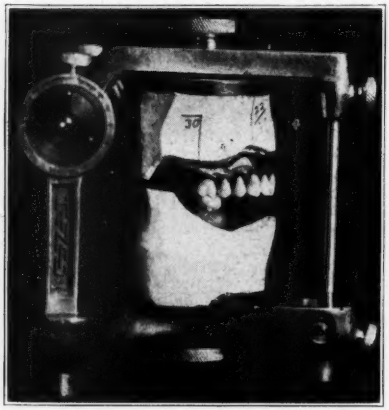

Fig. 12.—Centric occlusion of molars.

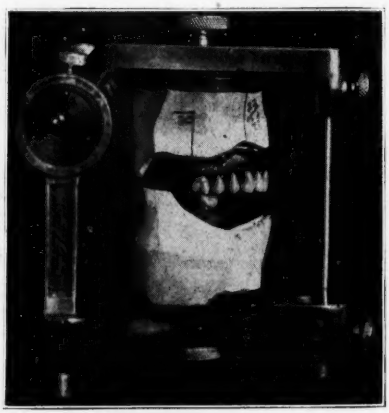

Fig. 14.—Balancing position of right molars.

sulci following the ridge-guide lines of its occlusal surface. (Fig. 11.)

STEP THREE

With the twelve maxillary teeth in such positions, we proceed to arrange the mandibular posterior teeth. Most orthodontists consider the mandibular first molar as the key to the occlusion (Fig. (12). Whether the idea is borrowed from another specialty or is an expedient dictated by experience, I do not know. In any case, I choose to place the first molar as the initial step in setting up the mandibular denture. The first molar is waxed

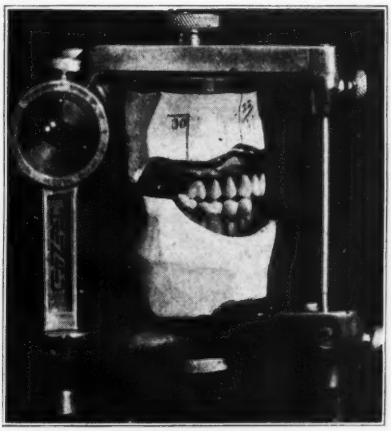

Fig. 15.—Mandibular second providing distal balance in protrusive ranges.

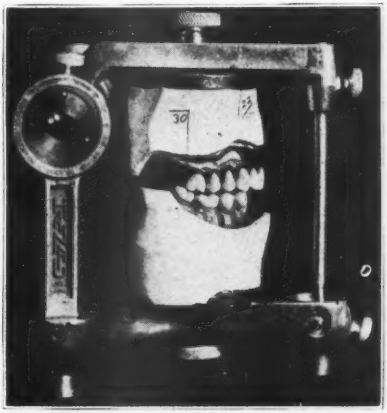

Fig. 17.—Balancing position.

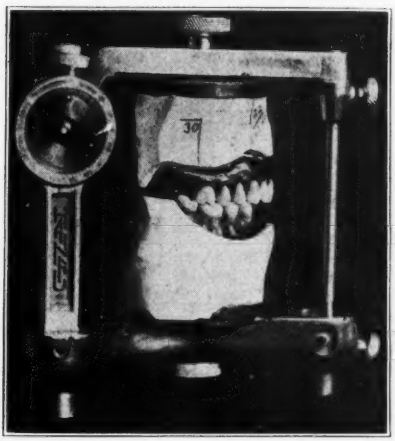

Fig. 16.—Anteroposterior plane of second molar approximating plane of its condylar guidance.

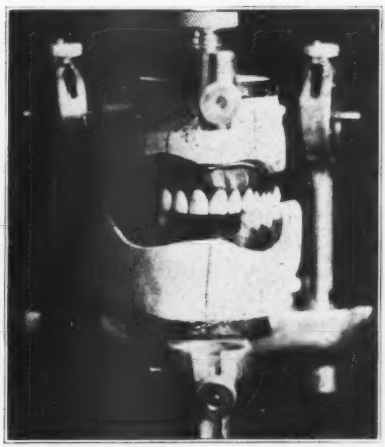

Fig. 18.—Case showing that when all posterior teeth are set, the incisal pin may be removed for placing the anterior teeth.

to its correct relation with the occluding maxillary molar in centric occlusion. The articulator is shifted to lateral range positions and the positional relation of these two molar teeth is readjusted as necessary to provide balance in all lateral relations, as shown in Figures 13 and 14. The mounting wax is now cooled to preserve these relations throughout subsequent operations. With one mandibular molar placed, the one for the opposite side is treated in like manner.

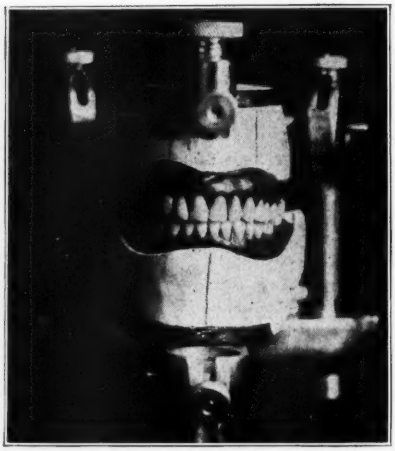

Fig. 19.—Centric occlusion (front view).

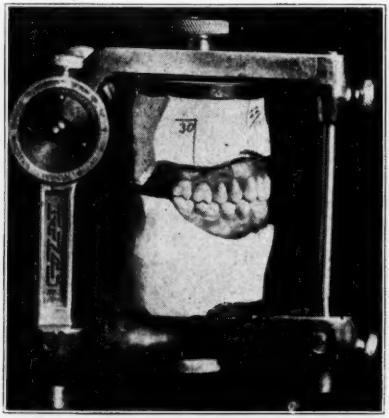

Fig. 21.—Working relation (right).

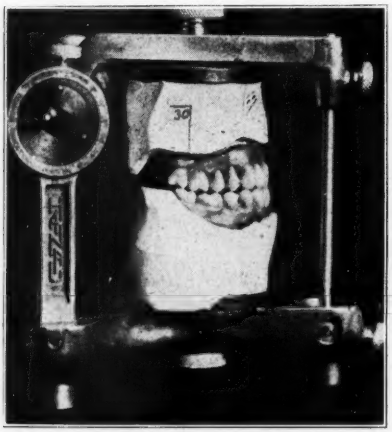

Fig. 20.—Protrusive relation.

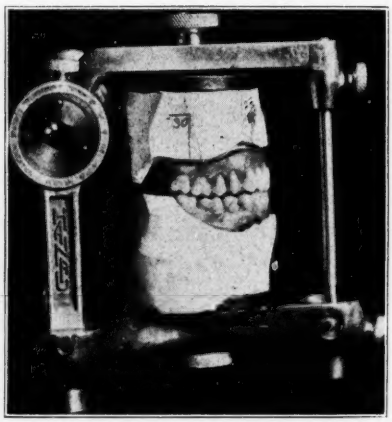

Fig. 22.—Balancing relation (right).

STEP FOUR

The mandibular bicuspids are next placed and adjusted and alined with the same test movements as for the first molars. Some slight positional shifting of the maxillary bicuspids may be necessary during this step, but no gross change is necessary when suitably sized and shaped teeth have been selected.

The relation of the maxillary cuspid and mandibular first bicuspid are tested in the direct protrusive range and any excess contact is relieved by grinding from both teeth. The cuspid position is not altered, for its location has been pre-

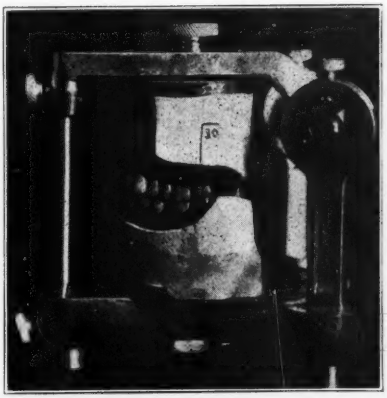

Fig. 23.—Flatter cusps and sharper curve.

Fig. 25.—Occlusal view of channel teeth.

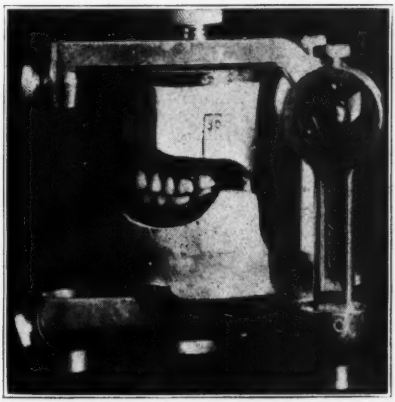

Fig. 24.—Centric occlusion (side view). (Channel teeth.)

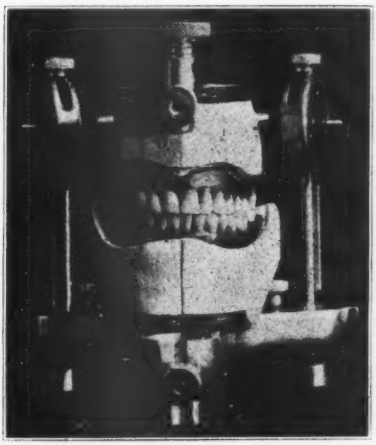

Fig. 26.—Centric occlusion (front view).

viously determined by esthetic requirements.

The first molars and second bicuspids may lack occlusal contact in this protrusive range without harm to the ultimate efficiency of the case, for the second molars are yet to be placed and will provide distal balance.

Until these last two tests, we have not used the protrusive movement, the six mandibular teeth having been placed only by lateral movements and centric occlusion.

STEP FIVE

We next place the second molars.

With the articulator in protrusive range, the mandibular second molar is so placed as to provide balance with the distoclusal aspect of the maxillary first

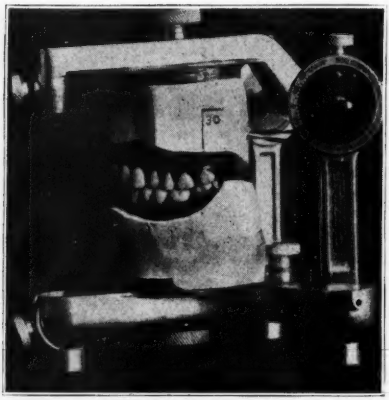

Fig. 27.—Centric occlusion (side view).

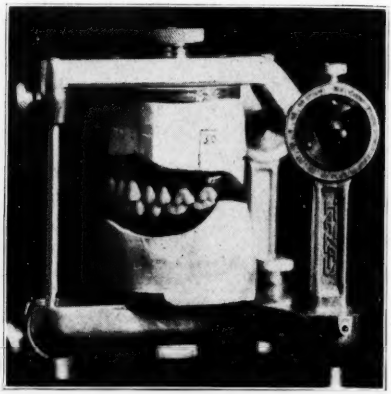

Fig. 29.—Centric relation with higher cusped teeth. The compensating curve is flattened.

Fig. 28.—Occlusal view of Hall's inverted cusp teeth.

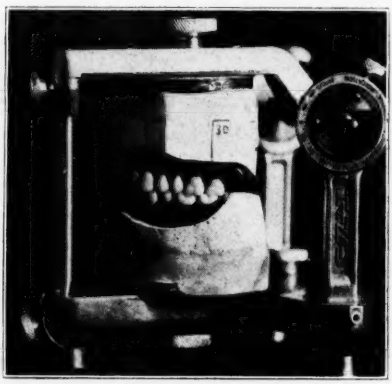

Fig. 30.—Same teeth as in master case but showing a flatter curve to compensate for flatter condylar guidance.

molar (Fig. 15); is returned to centric occlusion (Fig. 16), and is swung to the right and left lateral ranges (Fig. 17), the second molar position being altered so as to provide respective balances.

The general inclination of the occlusal surface of the second molar, anteroposteriorly, will be found to approximate the plane of its condylar guidance (Fig. 16).

The maxillary second molar is next placed so that it will provide balance in all range positions and centric occlusion.

The second molars of the opposite side are then placed with like procedures and tests.

The sixteen posterior teeth have now been positioned in accordance with the mechanical requirements of the articu-

lator setting, as to condylar and incisal guidances.

STEP SIX

The incisal pin may now be removed, for the set posterior teeth are an equivalent guide for the mechanics of setting the mandibular anterior teeth (Fig. 18). Beginning with the cuspids and working toward the median line, the mandibular anterior teeth are placed one by one in a position compatible with the posterior arrangement and acceptable to esthetics, the articulator being moved into its several range positions to confirm each tooth's placement. Modification of tooth form and incisal form by stone grinding may be desirable on the anterior teeth. (Fig. 19.)

Fig. 31.—Same anterior arrangement in all cases, the only variant being in bicuspids and molars.

This brief outline of procedure for setting up the full denture is offered as applicable to any modern articulator device and with any teeth.

Now that our master case has reached the final stage in the setting up, a little further study will be devoted to such modifications as would occur from the use of other cusp forms or from other types of condylar guidance; in other words, changing the height of one tower or the pier in the second illustration.

The following supplementary cases illustrate the resultant compensating curves when one factor at a time is changed, as compared with the master case.

1. Figure 23 shows the same condylar guidance but employing the old time flat cusped posterior teeth. The resultant compensating curve is sharper and the incisal overbite is decreased.

2. Figures 24-25 show the same condylar guidance but employing the very modern channel posterior teeth whose anteroposterior cusp is flat (introduced by Dr. Sears). The result is an increased (sharper) compensating curve and elimination of overbite.

Fig. 32.—Varying overbites to accommodate varying cusp heights and condylar guidance.

3. Figures 26-28 show the same condylar guidance but employing the inverted cusp posterior teeth brought out by Dr. Hall. These teeth eliminate cusp height not only anteroposteriorly but laterally as well. The effect on compensating curve and incisal overbite is comparable to that shown in the two previous groups.

4. Figure 29 shows the same condylar guidance, but employing higher cusped posterior teeth than in the master case. The result is a decreased (flattened) com-

pensating curve with the same incisal guidance.

Figures 22-29 show the effect of variations in cusp heighth on compensating curve, other factors remaining unchanged.

6. Now, in Figure 30, we change the condylar guidance to flat and use the same teeth as in the master case with the result that the compensating curve is much flattened with the same incisal guidance.

In all of these cases, the maxillary anterior teeth have been set in like positions (Fig. 31). The mandibular anterior teeth have been set approximately

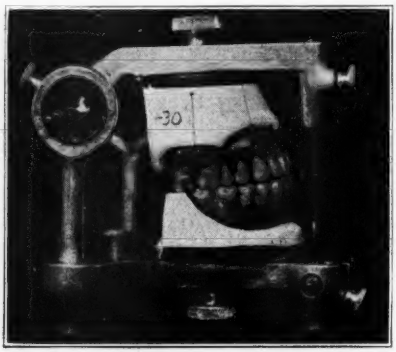

Fig. 33.—Protrusive balance with reversed (or negative) condylar guidance, showing reversed compensating curve in the molar region.

alike, but some of the incisal edges have been ground off to accommodate posterior mechanical requirements. Indistinct lines in Figure 32 indicate the variation of overbites compatible with the several cusp heights.

Figure 33 shows a case presenting the reversed condyle indication in the articulator. This condition is unusual and rather freakish; nevertheless, we should be prepared to cope with the condition when it arises.

Remembering the articulation law bearing on the relation between condylar guidance and compensating curves, we realize that, as the condylar guidance raises or lowers, so the compensating curve reacts proportionately and directly. Thus, with a reversed condylar guidance, we should build a reversed compensating curve, as seen in Figure 33.

A patient presenting a steep condylar guidance will probably have well-formed ridges, or will have recently lost the natural teeth; or has not reached his dotage. For such a patient, quite normal cusp heights may be used. The associated mandibular movements will exhibit scant lateral ranges.

A patient presenting flattened condylar indications will probably be more senile, or the mandibular ridges will be more atrophied. The mandibular movements exhibit wider lateral ranges, and flatter cusps are indicated. Such patients should be given the advantages offered in Sear's channel teeth and in Hall's inverted cusp teeth.

For full prosthetic dentures, the problems of mastication vary so far from like problems with natural dentures that we feel sure that these new tooth forms will provide, or lead us on to, modifications of natural posterior occlusal forms for prosthetic restorations, which will greatly enhance masticatory efficiency, reduce ridge atrophy by practically eliminating cusp trauma and greatly simplify full denture construction.

We believe that most all cases presenting condylar guidances of less than 20 degrees or those wherein the disparity between right and left sides is great will show correction and return to about 30 degrees after they have been provided with balanced dentures that are occasionally reground to facilitate and promote recovery.

Building originally to condylar guidances widely variant between right and left does not "tend to perpetuate the deformity," as has been claimed by some prosthetists.

We do not consider deep overbite as being desirable or practicable in prosthetic full dentures. However, this statement should not be interpreted to mean that we endorse the stereotyped end-to-end setting up which has come to be universally employed as an expedient with which to avoid mechanical difficulties, offering the easy way out.

An overbite of from 1.5 to 3 mm. can well be incorporated in setting up dentures and thus greater incisal efficiency may be afforded our denture patients.

Many cases present an opportunity to use an overjet of from 2 to 5 mm., in which instances the incisal occlusion is less likely to become a stumbling block.

In conclusion, the denture prosthetist must assemble his data correctly; register it properly in the adjustment of his articulator; select posterior teeth for the case with even greater care for mechanical requirements than the care exercised in satisfying esthetics in the selection of anterior teeth; and then so assemble these teeth as to harmonize all the factors in the construction of comfortable and efficient dentures.

ROOT RESECTION AS A CURE FOR CHRONIC PERIAPICAL INFECTION: A HISTOLOGIC REPORT OF A CASE SHOWING COMPLETE REPAIR*

By EDGAR D. COOLIDGE, B.S., D.D.S., Chicago, Ill.

ROOT resection, or apicoectomy, is the surgical removal of a portion of the root apex of a tooth exposing in cross-section the cementum, the dentin and the root canal, with its content, to possible contact with the connective tissue of the body. The outcome of this operation depends on the reaction of the connective tissue to contact with these exposed surfaces.

Normally, the dentin is not brought in contact with the connective tissue. From the beginning of its formation, the dentin is covered by cementum, and it remains covered by this substance unless exposed through some abnormal condition. If fracture of a portion of a root occurs, and the dentin comes in contact with the connective tissue, the connective tissue cells begin immediately to resorb the fragment and the exposed root end or to cover them with a new cement substance. In other cases, cementum may be deposited without previous resorption directly on the exposed surface of the dentin.

Figure 1, from a case described by Boulger,[1] illustrates the behavior of the connective tissue toward accidentally ex-

*From the Research Department (Director, Rudolf Kronfeld) of the Chicago College of Dental Surgery, Dental Department of Loyola University.

1. Boulger, E. P.: Histologic Studies of a Specimen of Fractured Roots, J. A. D. A., 14:1778 (Sept.) 1928.

posed dentin. Here, an accidental fracture had occurred many years previously in a tooth with a vital pulp. The apex of this tooth broke away, and the dentin thus came in contact with the peridental tissue. Evidently, resorption of dentin first took place and, later on, new cementum *(B)* was deposited on the jagged surface of the dentin. Peridental membrane *(A)* can be seen where the root was broken away, and a new peridental space, uniform in width with that along the sides of the root, has been formed. A little fragment of the root *(C)* lies to one side, but the main fragment is outside the focus of this picture. The pulp in this case was found to be vital, and repair of this type is what has been seen to occur, as a rule, where dentin is exposed while the pulp remains alive. Bauer[2] has shown by experiments on animals, in which he resected the root ends of the teeth, that, in a few months after the operation, the cut surfaces of the dentin were covered with newly deposited cementum. New alveolar bone filled in the space formerly occupied by the root apices and a new peridental membrane formed so that the resected root ends of the teeth were completely surrounded by a functioning peridental membrane.

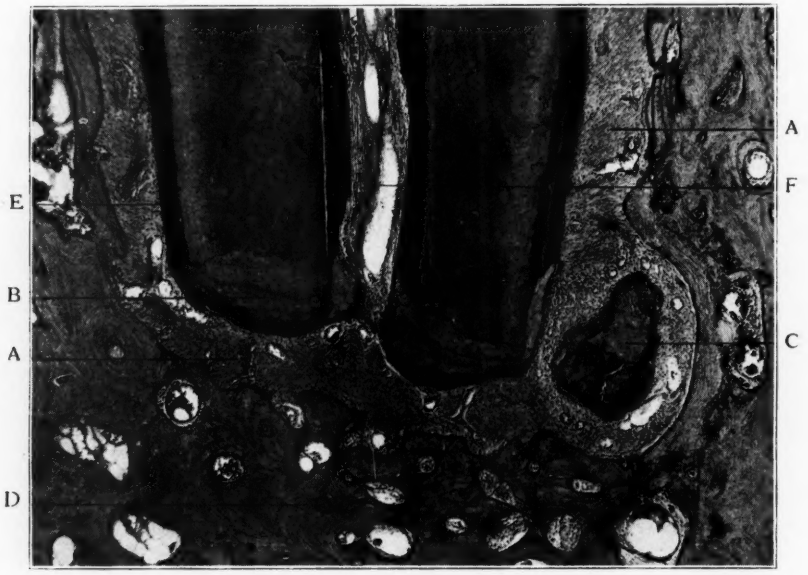

Fig. 1.—Illustration (Fig. 4) of Boulger's case of a fractured root. *A*, periodontal membrane. *B*, secondary cementum deposited on fractured end of root following resorption of the dentin. *C*, fractured piece of cementum. *D*, bone in place formerly occupied by apex of the tooth. *E*, primary cementum on the surface of the root. *F*, pulp.

The analogy in the case reported by Boulger and the animal experiments of

2. Bauer, W.: Mikroskopische Befunde an Zaehnen und Paradentien nach Experimenteller Wurzelspitzenamputation unter besonderer Beruecksichtigung der Bedeutung funktioneller Auswirkung, Ztschr. f. Stomatol., 23:122-135 (Feb.) 1925.

Bauer lies in the fact that, in each case, a vital, uninfected pulp was present in the root canals at the time when the dentin became exposed, so that repair was immediately begun without septic interference. In the case now to be described, a chronic infection existed about the root end and involved the dentin, cementum, peridental membrane and alveolar bone before the canal was treated and filled preparatory to the operation.

In cases in which root resection is indicated in the human mouth, there is usually present an infection of long standing. In a few cases, when roots have been resected because of accidents in root canal operations following live pulp removal (broken broaches, etc.), we have a condition similar to that described by Bauer in his experiments. In most cases of root resection, the condition to be met is one of chronic infection involving portions of the dentin and cementum. The opinion that has been held by most investigators and clinicians is that the surface of dentin exposed by the resection, having been subjected to chronic infection, cannot be covered by new deposits of cementum.

Cases of resection have been reported showing deposits of new cementum covering only that part of the resected surface which was cementum, but the dentin was always shown to be bare of a new deposit. A case like this has been described by Kronfeld.[3] (Fig. 2.) He shows newly deposited cementum *(C')* covering the old

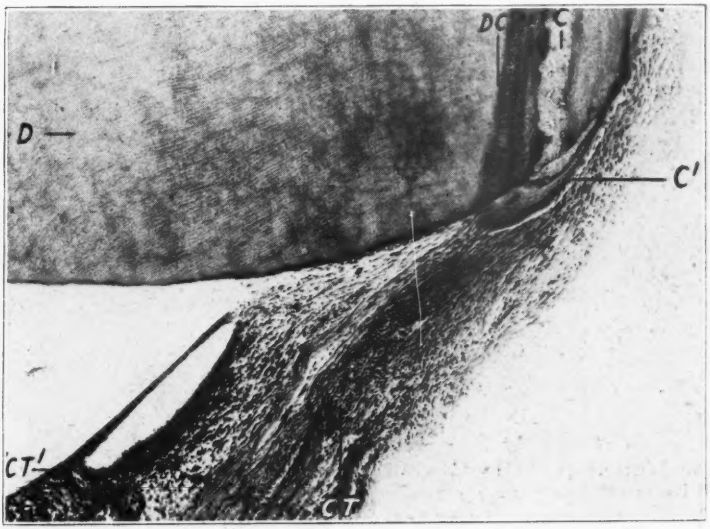

Fig. 2.—Illustration (Fig. 3) of Kronfeld's case of a resected root. Buccal portion of root end. *D*, dentin, *DC*, dentinocemental junction. *C*, old cementum on the root surface. *C'*, cementum newly deposited since the operation ending at the dentinocemental junction. *CT*, infiltrated connective tissue. *CT'*, densely infiltrated connective tissue torn away from the bare dentin.

3. Kronfeld, Rudolf: Zur Frage der Wurzelspitzenamputation, Ztschr. f. Stomatol., 26 (Nov.) 1928.

cementum on the resected surface *(C)*, but the dentin remained bare, and the tissue covering the dentin shows a continued inflammation *(CT)*. From this limitation of the deposit of new cementum, he concludes that the dentin harbors infection in its tubules and, therefore, no deposit of cementum could occur. He states that a different filling in the canal or perhaps some different method of treating the canal might give a different result and produce a condition more favorable for these biologic changes in the tissue.

The tooth now to be described is an upper left first bicuspid of a woman in young adult life at the time the case was under treatment. A roentgenogram (Fig. 3, left) shows a large area of bone destruction, involving the alveolar bone

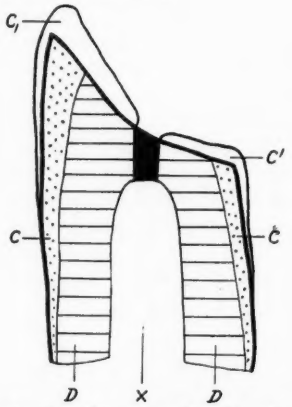

Fig. 4.—Drawing of section through specimen. *D*, dentin. *X*, space formerly occupied by dowel of crown. *C*, cementum formed before resection. *C'*, cementum formed after resection. The heavy black area indicates guttapercha root canal filling.

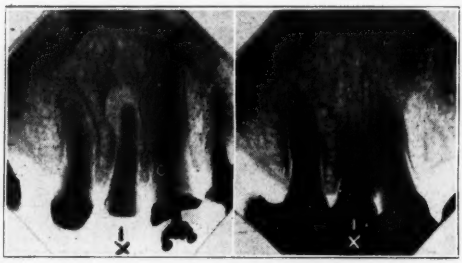

Fig. 3.—Left: Upper first bicuspid showing an imperfect root canal filling and an extended area of bone resorption, just before resection, July, 1914. Right: Same tooth, August, 1928. The area formerly occupied by the apex and granuloma is entirely filled in by bone.

as well as the peridental tissue in the apical region. An attempt was made to open the canal and drain this area through the tooth. After several treatments with antiseptics, the root was filled with guttapercha, June 12, 1914, the operator being unable to reach the apex of the root satisfactorily. July 15, 1914, the root was resected to the level where the filling ended.

Attention is directed to the appearance of an incomplete guttapercha filling, in Figure 3, right, which should be compared with the photomicrograph in Figure 5, showing the guttapercha ending level with the stump of the dentin. This is easily explained by the manner in which the root is resected, leaving a very oblique surface so that the shadow of the lingual angle is considerably higher than the shadow of the guttapercha; which gives the appearance of an incomplete root filling.

In Figure 3, right, taken in 1928, fourteen years later, it is quite evident that new bone had completely filled in the

space where the apex and granuloma had been removed. A uniform peridental space seems to have been formed around the resected root end as far as the roentgen-ray evidence can be interpreted. The resected root served as a bridge abutment for fourteen years and was still as secure and comfortable as it had been at any time. However, the patient had developed symptoms of focal infection and, on other professional advice, she had the tooth extracted and returned it to me for observation and study.

The specimen was sectioned buccolingually in serial sections and all sections were preserved. In order to make the photomicrographs more easily understood, a drawing is first shown (Fig. 4) to represent the findings in a central section through the specimen. The drawing shows the border of the oblique resected surface, exposing a short piece of the guttapercha canal filling underneath the dowel of the artificial crown, which was supported by the root. The newly deposited cementum (*C'*) is represented

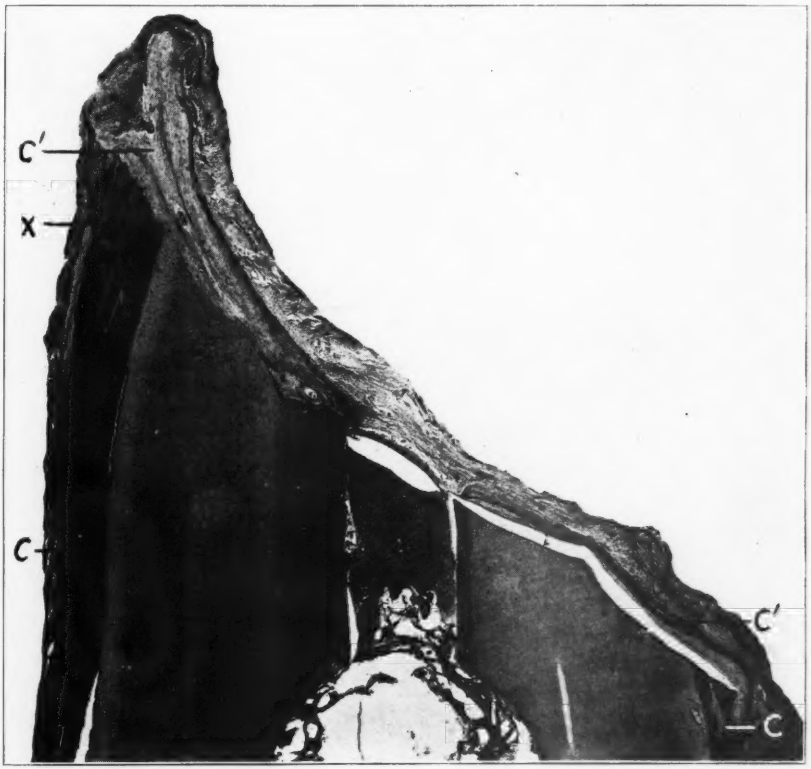

Fig. 5.—Buccolingual section through resected root as illustrated by Figure 4. *C*, old cementum. *C'*, new cementum deposited on resected surface. (×25.)

by the unshaded space around the root end. The thick dark line represents the surface of the root immediately after the root resection.

A photomicrograph of a central section of the resected root is shown in Figure 5, which corresponds to the drawing in Figure 4. We see the irregular, oblique border of the root resulting from the operation. The buccal border (right) was cut considerably shorter than the lingual (left), and the guttapercha filling in the center extends flush with the border of the root stump and is seen to very nearly fill the diameter of the canal. The slight spaces between the guttapercha and the walls of the dentin were made when the specimen was decalcified and treated with ether and xylene (xylol), which caused a shrinkage in the mass of guttapercha. On the buccal and lingual surfaces, there can be seen the dark colored cementum *(C-C)*, which is easily distinguished from the newly deposited cementum *(C'-C')* on the resected surface. On the right side, the new

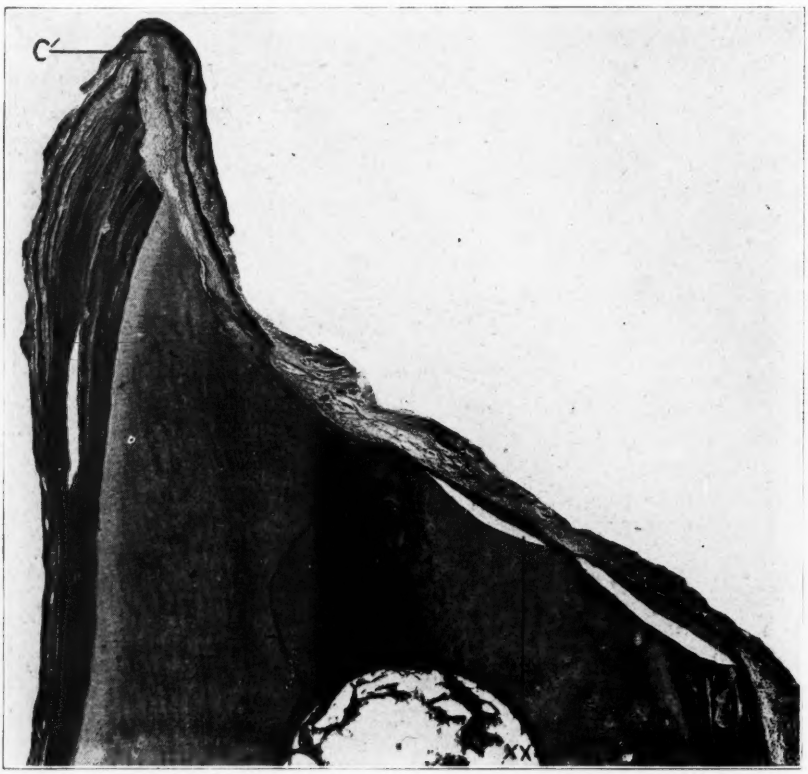

Fig. 6.—Oblique section of root end showing new cementum covering the entire surface exposed by resection. The new cementum on the resected surface is continuous with new cementum on the outer surfaces of the root at *C'*. (×25.)

cementum became separated in sectioning (an artefact), and is seen in higher magnification to fit perfectly into the surface of the dentin (Fig. 8). The new cementum can be seen covering the entire length of the exposed surface of the dentin to the border of the guttapercha in the canal. Immediately across the exposed end of the guttapercha is a dense band of

Fig. 7.—Higher magnification of area *x* in Figure 5. *D*, irregular resorbed surface of dentin. *C*, old cementum. *V*, small blood vessel and connective tissue imbedded in new cementum. *C'*, uncalcified cementum and cementoblasts. *F*, bundles of Sharpey's fibers extending between cementum and alveolar bone. (×160.)

fibrous connective tissue without any sign of inflammatory reaction. In the discussion of the behavior of the connective tissue toward exposed surfaces of dentin, it was stated that a new deposit of cementum might occur at once or that resorption might occur first and be followed by a deposit of cementum. In this case, both conditions can be seen. On the left side, the resected surface of the dentin and cementum shows that resorption of both had taken place before the new cementum was laid down on the jagged surface. On the right side, the dentin shows a more regular surface, with two slightly concave areas which doubtless were made by the bur during the operation. The shape of the surface of the new cementum shows conclusively that it fits perfectly into the slight irregularities on the root surface, but was torn away in

sectioning. The peridental membrane covering the resected root end came away with the tooth in extraction.

In Figure 6, a more oblique section and one more distant from the center, the canal is not shown in the picture. The cementum deposit was continuous over the entire resected surface. This photomicrograph also shows how resorption preceded the new deposit of cementum on the left side and that almost no resorption took place on the right where cementum was deposited immediately upon the cut surface of the dentin. New layers of cementum were deposited on the buccal and lingual surfaces of the old cementum during the years from operation to extraction, and the new cementum is in direct connection and continuous with that on the resected surface. This is especially well shown in the upper left corner of Figure 6 (*C'*).

Figure 7 is a high magnification of area *x* in Figure 5, showing the new cementum on the resected surface near the junction of the dentin *(D)* with the old cementum *(C)*. A small blood vessel *(V)* surrounded by uncalcified cementum can be seen enclosed in the regular layers of new deposit. Bundles of normal appearing fibrous connective tissue *(F)* extend from the surface of the new cementum toward the alveolar bone. Fortunately, this mass of tissue remained attached when the root was extracted and furnishes an important link in the chain of evidence that a resected root which was previously infected and surrounded by pathologic tissue, under certain conditions became reestablished in a normal relation and functioned in a normal manner. The formation of cementum was still in progress when the tooth was extracted, as can be seen by the presence of a thin layer

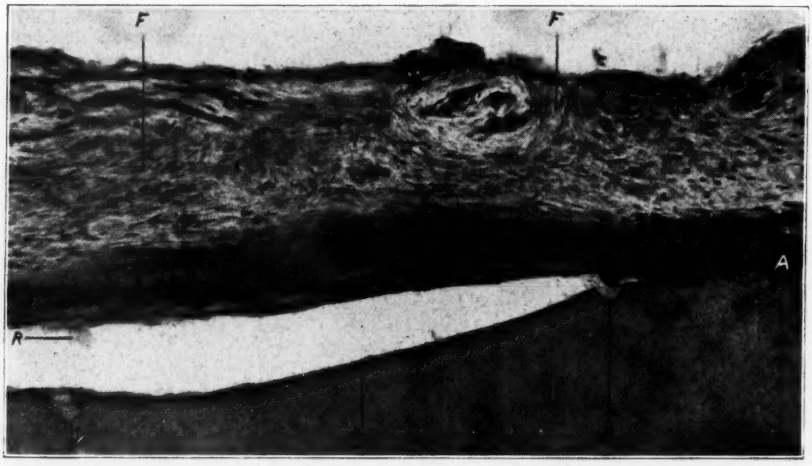

Fig. 8.—Higher magnification of area *xx* in Figure 6. *A—B*, cementum attached to slightly resorbed dentin. *D*, smooth surface of dentin cut by the bur during operation. *R'*, small area of resorption from which projecting piece of cementum *R* was torn by preparation. *F*, peridental membrane. (×160.)

of uncalcified cementum *(C')* and the cementoblasts on the surface of the deposit.

A high magnification of the right side shown in Figure 6 at *xx* is seen in Figure 8. The dentin shows an unusually smooth surface, which cannot be found where resorption has occurred, but only as the result of cutting by an instrument. From *A* to *B*, the cementum is connected with the dentin which was superficially resorbed. From *B* to the left, the connection has been broken artificially, but it is quite evident that it was attached, because a very slight resorption in the dentin can be seen at *R'*, and a small projection of cementum (*R*) seems to have been drawn away from its socket. The connective tissue adhering to the cementum shows the typical fibrous structure of a healthy peridental membrane.

A central section in high magnification is seen in Figure 9, which shows the canal filling (*G*) and the fibrous capsule immediately above it. The space separating these structures was, as already mentioned, produced by the shrinkage of the guttapercha in the preparation of the specimen. The cementum ends at the margin of the root filling and dense fiber bundles (*F*) can be seen extending from one side of the canal to the other, stretching across the end of the guttapercha filling. On the right side, where cemen-

Fig. 9.—Area over root canal filling; space between guttapercha *(G)* and connective tissue *(F)* caused by shrinkage in preparation. *S*, spaces between dentin and cementum and between dentin and guttapercha due to shrinkage. *V*, small blood vessel enclosed by cementum. *R*, resorption of dentin filled by new cementum. (×100.)

tum was deposited on the smooth surface of the dentin, the artificial separation can be seen. On the left side, cementum was deposited on the irregularly resorbed surface of the dentin (*R*) and a small blood vessel (*V*) is enclosed within the new deposit.

Figure 10 shows the tissue at the canal opening adjacent to the guttapercha filling. The dense band of fibrous connective tissue (*FC*) is that part lying close to the guttapercha. A capillary filled with red blood cells (*V*) lies just above. Immediately above this is a typical connective tissue showing nuclei of fibroblasts (*F*). No inflammatory cells have been found in any part of the tissue surrounding the canal filling nor in any of the tissue surrounding the resected surface.

This case differs so markedly from one reported by Thomas J. Cook[4] of Rochester, Minn., in recent literature that a brief comparison should be made to show the clinical significance of each case.

In the case described by Cook, the root of an upper central incisor had been filled and resected ten years previously. The roentgenogram in Figure 1 of his article shows a very incomplete root canal filling and a large area of bone resorption where the root was resected. An incomplete root canal filling should

Fig. 10.—High magnification of connective tissue immediately over root canal filling. *FC*, dense fibrous capsule covering guttapercha surface. *V*, capillary containing red blood corpuscles. *F*, fibroblasts. (×900.)

4. Cook, T. J.: Dental Granuloma Ten Years After Apicoectomy, Dent. Cosmos, 71:1065 (Nov.) 1929.

be a contraindication for root resection in all cases, as the vacant space in the canal would be filled immediately with exudate from the tissue and would harbor bacteria, which would be a constant source of reinfection of the wound, preventing healing. The fact that there was round cell infiltration in the granuloma surrounding this resected root and streptococci were found would only indicate an individual failure and one as easily explained as a failure in almost any other surgical operation. Cook emphasized the importance of the evidence in the roentgenogram. We wish also to emphasize the importance of a comparison of the roentgenograms in Figure 3, left and right, of this paper. Just as Cook has been able to show that a poorly filled root when resected may harbor bacteria and maintain an inflammation occasionally endangering the patient's health, so we wish to show that it is possible to eliminate a chronic infection by resection provided the root has been properly treated and filled before resecting.

Finally, we wish to state that we are aware that one case is not a sufficient basis for definite conclusions. It is difficult to obtain material of this kind because such teeth are rendering efficient service and the patient is hesitant to lose them. It is far easier to accumulate material for bacteriologic or histologic study when root filling has by clinical evidence been proved a failure. Such a case was that described by Cook. In our case, we were quite sure, from clinical and roentgenographic evidence, that the root was not a contributing factor in the patient's complaints, and the history of the case after the extraction, as well as the histologic evidence now recorded, proves that the first opinion was correct.

ROOT AMPUTATION: A STUDY OF ONE HUNDRED AND FIFTY-NINE CASES*

By THEODOR BLUM, D.D.S., M.D., F.A.C.D., F.A.C.S., New York City

IN my experience, root amputation is one of the most successful conservative operations in the field of oral surgery from the point of view of esthetics, practicability and service. If one is radical in his opinions regarding pulpless teeth, a discussion of this subject would be superfluous. Fortunately, in the minds of the majority of dental and medical practitioners, root canal therapy terminating in the filling of the root canals is still considered good practice.

Assuming the foregoing to be true, discussion of this mode of treatment based on the study of 159 cases seems appropriate. These 159 cases include the statistics of fifty cases selected at random and reported to Leroy M. S. Miner, of Boston, March 30, 1920, and of fifty-three cases prepared by my associate, H. L. Reiss, with recent clinical reexaminations as well as examinations by roentgen ray, vitality test of adjoining teeth and transillumination. Furthermore, 103 cases

*Read before the Section on Oral Surgery and Exodontia at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

which had been examined at intervals, but could not be seen at the office during the last two months have been included.

Most of the failures with this operation reported by others are due to the fact that the cases are not properly selected. Only incisors, cuspids and bicuspids should be considered, as a rule, while, in exceptional cases, the buccal or palatal roots of first molars may have to be operated on. If a patient presents himself at one's office for such treatment, it is not sufficient to examine just this one tooth or as many teeth as have to be amputated. The whole mouth must be examined in the usual fashion, clinically, and by a series of roentgenograms, pulp tests and transillumination. Also, the type of bite, as well as anything else which may seem important locally, must be determined. One must not forget the patient's general condition, as it must be taken into consideration whenever anything is attempted which may prove a burden to a weakened system.

After the clinical examination has been completed and everything found satisfactory, the roentgen-ray examination will finally prove whether or not one may proceed. As a general rule, root amputation is indicated, where, after the operation, enough alveolar process will be left to hold in position a serviceable root. This being the case, arrangements must be made for root-canal therapy, so that the operation can be performed as soon as possible after the root canals have been filled, to avoid the possibility of acute symptoms appearing. The statement is often made that root amputation can be performed only if one-quarter or one-third of the apical part of the root is involved. In answer, I would like to say that this depends on the length of the root.

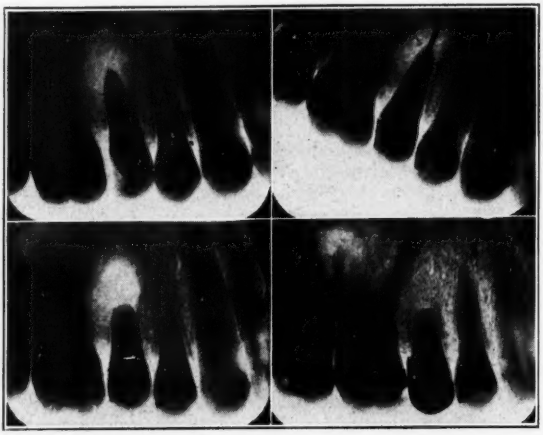

Fig. 1 (Case 8).—Acute purulent periostitis in the buccal region of the upper right second bicuspid and first molar. Treatment was instituted, Nov. 10, 1926. The upper left hand view was taken, December 3. Root canal therapy was instituted, December 9 (upper right). Root amputation was performed, December 12. The lower left hand view was taken, December 17. The lower right hand view was taken, Aug. 28, 1929.

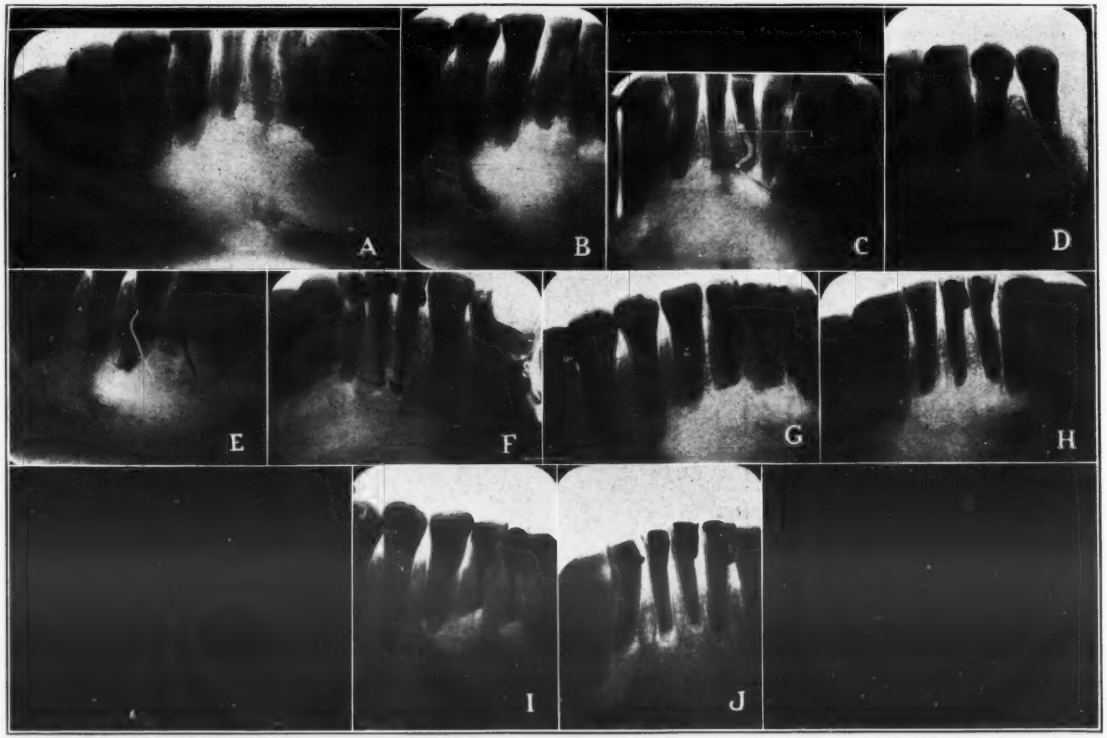

Fig. 2 (Case 15).—*A*, large cystic area (taken in November, 1922), later diagnosed as cystic adamantinoma. A more detailed view is given in *B*, *C* and *D*. Root amputation having been decided on, the root canals of the four lower incisors and the lower left cuspid were filled the same month (*E*, *F*) and the operation was performed, November 21. Nine weeks after the operation, *G* and *H* were taken. *I* and *J*, the last films taken, are dated July 26, 1929.

Before the surgical operation, additional roentgenograms will have to be taken to determine the condensation of the root-canal filling and to detect possible perforations.

Local anesthesia is the anesthesia of choice. After the patient has been prepared in the usual manner, a semilunar incision is made with the convexity toward the crown of the tooth, the lowest part of the convexity being approximately 0.5 cm. away from the free gingiva. The mucoperiosteal flap so outlined is elevated and held in position with a retractor. If the apex of the tooth or the apical area is not exposed, enough of the outer plate of bone in the apical region is removed with chisel and mallet to bring into view the apex or the granuloma or cyst membrane. As a rule, it will be well to expose the area sufficiently to avoid groping in the dark. In doing so, care must be taken not to injure the adjacent teeth, especially if they are vital. Before removing the apical part of the tooth, it is best to enucleate as much as possible of the granuloma or cyst membrane, as the case may be. Anyone with the slightest experience in this work will know that it is impossible to remove all this soft tissue from all sides of the exposed root without first cutting down the root-end with a round bur, beginning at the apex and going down toward the neck of the tooth until the cut root surface conforms with the general outline of the surrounding bone cavity. The removal of the apex is also imperative, because no one can tell with the naked eye whether or not any pathologic change has taken place in the substance of the apex. The round bur is to be preferred to the fissure bur because the removal of the apex with the fissure bur unquestionably necessitates

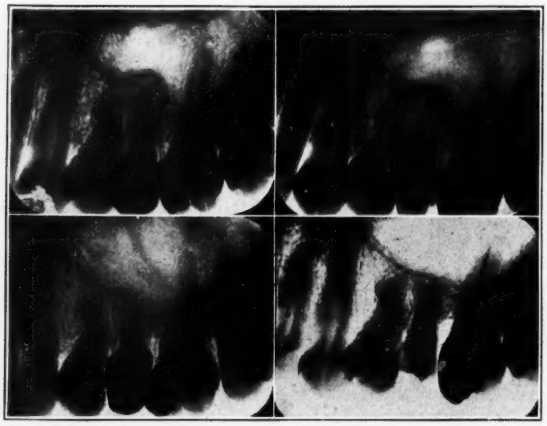

Fig. 3 (Case 17).—Appearance of region of the upper right second bicuspid. The complaint was slight soreness. Root canal therapy and root amputation were advised. The upper left hand view shows piece of metal in canal (Nov. 19, 1917). Root canal therapy was instituted, December 8 (upper right). The lower left hand view shows the bicuspid, March 29, 1924, root amputation having been performed, December 8. The lower right hand view was taken, August 26, 1929.

destruction of adjoining bone and more of the root itself than is indicated. I have seen root amputations performed in which, at the time of the operation the tooth had to be supported when using the bur. Such cases are failures from the start and should never have been attempted. Although the roentgen ray will give some idea as to whether the guttapercha fills the root canal firmly, the bur will have further burnished the filling material, which can now be easily inspected at the apical end.

It is routine practice in our office to see the patient the day after the operation and the third day. On the fifth, the sutures are removed, for which reason the patient is seen again the sixth day. During these visits, the field operated on is cleansed with cotton swabs and then painted with 25 per cent argyrol. A week after the operation, a roentgenogram is made, and again in four weeks, three months, six months and a year after the operation. Thereafter, a roentgenogram is made every year as long as the patient is willing to submit to it. This routine gives us a splendid opportunity to study the progress of the case, the filling in of bone as well as what seems to be the formation of a pericemental lamella and pericemental membrane around the cut end of the root.

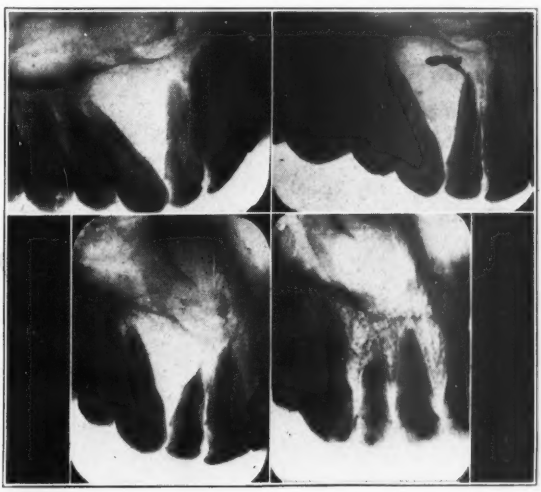

Fig. 4 (Case 48).—Radicular cyst in region of the upper right incisors and cuspid, originating from the lateral incisor (upper left hand view, taken, Oct. 9, 1924). The upper right hand view shows root canal therapy, October 14, the day on which root amputation of the lateral incisor was performed. The lower left hand view shows the first film taken after the operation (November 12). The lower right hand view shows the present condition (Sept. 4, 1929).

After all the débris has been removed from the bone cavity from under the flap and the remaining operative field, the area is carefully inspected again and all rough points of bone are smoothed. The flap is now replaced and held in position with as many sutures as is necessary. The suture material used in our work is dermal suture (Bauer & Black).

In April, 1918, I gave Arthur W. Smith, of Rochester, N. Y., the follow-

ing answers to his questions on apicoectomy for his report to the New York State Dental Society, which I take the liberty of incorporating in this paper, believing that it will throw additional light on the subject under discussion.

1. Do you consider root amputation advisable in any case? Apicoectomy is advisable in those chronic cases in which one can expect to have, after the operation, enough alveolar process left to hold the root firmly, and enough of the root remains to make it serviceable.

Fig. 5 (H. D.).—Chronic apical pericementitis of the upper left incisors, the pulp of which probably died from vibration from patient playing a saxophone. The upper left hand view was taken, March 15, 1917. The upper right hand view, taken, March 27, shows the root canal therapy. Operation was performed on the affected teeth, March 30. The lower left hand view is the first film taken after the operation (May 1). The most recent film (lower right) was taken in September, 1929. The alveolus has entirely regenerated around the apices, but not above that in the apical region of the lateral incisor, where, according to the description of the operation, the outer plate, and probably also the palatal plate, has been absorbed, destruction of the periosteum resulting.

2. *a*—In what cases or conditions? In cases of chronic apical pericementitis, radicular cysts, perforations or fractures near the apex; if, for whatever reason, the root canal cannot be filled to the apex.

b—On what teeth (anatomically)? Apicoecotomy can be performed on all teeth if the apical area is accessible. Ordinarily, only the teeth up to and including the second bicuspids are considered.

3. *a*—What do you consider the best filling to use in a root canal previous to amputation? Guttapercha.

b—Why? Because guttapercha is generally used as filling material, and apparently is tolerated by the tissues.

4. *a*—In what percentage of your cases have you had a normal regeneration of bone following the operation? In all well selected cases (which means about 98 per cent of all cases).

b—In what percentage has there been failure of recovery in the apical area? One per cent.

c—To what do you attribute these failures? First, to operating on badly filled roots (reinfection), and, secondly, to using the chisel for removing the apex (the root was split and had to be removed about a year later).

5. Do you advocate the use of the bur, the chisel, or both the bur and chisel for removing the root apex? A round bur starting at the apex and cutting toward the crown.

6. If you examine the teeth by roentgen ray at intervals after the operation, what have you found to be the average time (in months) in which bone regeneration has taken place? About six

months, this depending on the age of the patient and the size of the bone cavity (according to the roentgenogram, which does not show the early bone regeneration).

7. *a*—Do you consider it advisable to suture the incision after operation? Suturing is advisable in all cases if other conditions are favorable (if the root canal is filled before operation; if there is an average size bone cavity which will easily fill with blood; and if the flap is healthy).

b—If so, what are the advantages? There is a shorter period of treatment and less pain.

c—If not, what have you found are the objections? No objections, if conditions are favorable.

8. *a*—Should the operation be performed by the general practitioner or by the specialist? By the specialist or by the general practitioner if he is well trained to do the work and if he operates frequently.

On account of the fact that my report to Dr. Miner has not been previously published, I feel that it may give the student of this subject an additional point of information. I therefore cannot see any objection to citing the same:

FIFTY CASES

Male: 21; Female: 29.

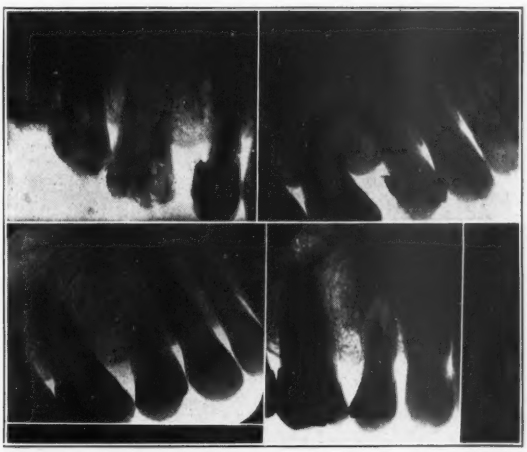

Fig. 6 (Author's case).—Buccal fistula discharging pus (to author's knowledge, for about one year), in the region of the left maxillary bicuspid, originating from the upper left first bicuspid. The upper left hand view (taken in January, 1906) gives an approximate idea of the condition after the root canal was filled, namely, chronic apical pericementitis. Root amputation was performed by a general practitioner in January, 1906. The upper right hand view was taken a few weeks after the operation; the lower left hand view, Dec. 16, 1921. The lower right hand view, taken, June 26, 1925, shows fracture of the root of the first bicuspid, the cause of which is unknown to the author.

Age

Youngest: 17 years; Oldest: 70 years. Average: 36½ years.

Earliest operation: Aug. 6, 1913.

Latest operation: Jan. 6, 1920.

Longest interval between operation and last visit: 5 years, 5 months.

Shortest interval between operation and last visit: None.

Average: About 9¾ months.

Condition before operation: (a) Chronic apical pericementitis: 42. (b) Cyst (radicular): 8.

Number of teeth involved: (a) One—28 cases. (b) Two—19 cases. (c) Three—3 cases.

Maxilla	*Mandible*
Central: 26	Central: 5
Lateral: 16	Lateral: 2
Cuspid: 12	Cuspid: 3
First bicuspid: 5	Third molar: 1
Second bicuspid: 5	

Failures: 1.

Doubtful: 1.

Successful (apparently): 47.

Lost on account of dental work performed 1½ years later: 1.

For further study, I may include in this paper the table of fifty-three cases compiled from my records by my associate. A comparison with the table from 1920 will readily show how primitive the early report is as compared with the recent one of Dr. Reiss, which includes all the latest methods of examination at our disposal.

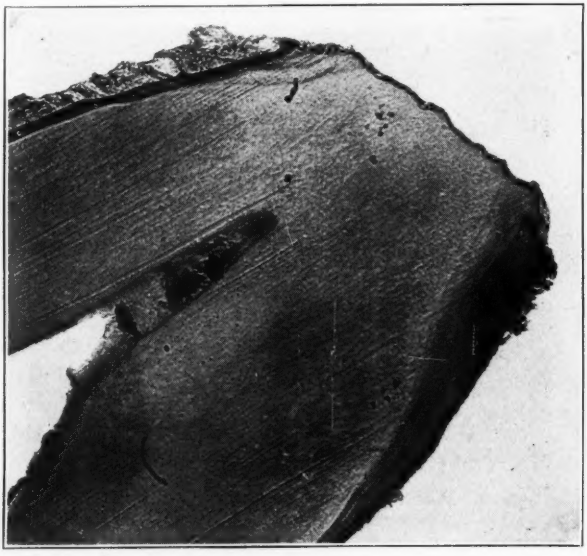

Fig. 7.—Section of apex of tooth (author's case).

Root canals filled before operation: 49 cases.

Root canals filled during operation: 1 case.

Root canals filled after operation: 4 cases.

Root canals filled with guttapercha: 49 cases.

Root canals filled with oxychlorid of zinc: 1 case.

Apex removed with chisel: 6.

Apex removed with bur: 66.

Apex removed with chisel and bur: 3.

Wound sutured: 26 cases.

Wound packed: 24 cases.

STATISTICS OF FIFTY-THREE CASES OF ROOT AMPUTATION

Male: 25; Female: 28.

Clinic patients: 13; Private patients: 40.

Age

Youngest: 10 years.

Oldest: 50 years.

Average: 30 years.

Earliest operation: Jan. 8, 1916.

Latest operation: May 12, 1929.

Longest interval between operation and last visit: 13 years, 6 months.

Shortest interval between operation and last visit: 3 months.

Time Elapsed

5 cases, 3 months; 7 cases, 6 months; 11 cases, 1 year; 4 cases, 2 years; 5 cases, 3 years; 5 cases, 4 years; 1 case, 5 years; 4 cases, 6 years; 2 cases, 7 years; 1 case, 8 years; 3 cases, 9 years; 1 case, 10 years; 2 cases, 11 years; 1 case, 12 years; 1 case, 13 years.

Condition before operation: (a) Acute apical pericementitis, 1 case. (b) Chronic apical pericementitis, 34 cases. (c) Cyst (radicular), 17 cases. (d) Cyst (adamantinoma), 1 case.

Number of teeth involved: (a) One, 32 cases. (b) Two, 11 cases. (c) Three, 9 cases. (d) Five, 1 case.

Maxilla	*Mandible*
Central: 25	Central: 6
Lateral: 28	Lateral: 3
Cuspid: 16	Cuspid: 1
First bicuspid: 4	
Second bicuspid: 7	

Root canals filled before operation: 51.

Root canals filled after operation: 1 (was attempted but failed—teeth removed 3 weeks after operation).

No record: 1.

Root canals filled with guttapercha: 48.

Root canals filled with copper amalgam: 2.

Root canals filled with guttapercha and osogen: 1.

Root canals filled with silver nitrate and guttapercha: 1.

Apex removed with bur: 47.

Apex removed with chisel: None.

Apex removed with bur and chisel: 2.

No record: 4.

Wound sutured: 44.

Wound packed: 4.

Wound packed and sutured: 3.

No record: 2.

Failures: None.

Doubtful: 2 (slightly loose).

Successful: 47.

Lost on account of subsequent dental work: 2.

One patient was operated on twice, two years elapsing between the first and the second operation. Root-canal therapy was again instituted prior to second operation.

Transillumination before: 50—1 revealed shadow; similar shadow five months later.

Transillumination after: 27 revealed shadows; 25 negative.

One case was not transilluminated before or after as the patient had amputated teeth missing, which she claimed were removed seven years after the operation, stating that they loosened and her general health improved after all her pulpless teeth were removed.

Condition of teeth after operation: Firm, 45; fairly firm, 2 (slightly tender to percussion and one tender in rainy weather). Slightly loose, 2; extracted, 2; no record, 2.

Occlusion after operation: Good, 28; active orthodontia, 1; traumatic, 6; fair, 7; tip-to-tip bite, 1; marked overbite, 5; no occlusion, 5; prognathism, 1.

Pulp test of adjoining teeth before operation, 12.

Pulp test of adjoining teeth after operation, 47.

In one case, a pulp test revealed that the adjoining tooth, the upper left cuspid, (the upper left central incisor and upper left lateral incisor had been amputated) had become pulpless since operation, although the patient was not aware of it.

Reaction of Patients: Pleased, 49; not pleased, 4.

All patients were operated on under procain anesthesia.

Five cases were in the acute stage. These were all incised and root amputations performed from one to three weeks after incision, after root-canal therapy had been accomplished.

Case 7.—The patient had the upper left incisors and cuspid removed three weeks after operation because she could not tolerate subsequent root therapy which was attempted. She said that she was too nervous for this work though she tolerated the operation satisfactorily under procain. Of course, this patient was not pleased.

Case 16.—The patient complained of puffiness in the cheek in the region of operation.

There was a cicatrix at the site of operation, slightly tender to pressure. This patient was not pleased.

CASE 28.—The patient had amputated teeth removed seven years after the operation because, as he claims, they loosened. He stated also that after removal of all pulpless teeth, his general health improved. This patient was pleased as the teeth remained for seven years and this was a longer time than he had expected they would be retained. He was 47 years old when he lost them.

CASE 36.—This was the only case that presented undetected, pulpless teeth (the upper left cuspid) adjoining the amputated lateral incisor. Operation had been performed on the incisor nine years previously. Use of the roentgen ray and transillumination of the cuspid revealed no pathologic condition. The cuspid did not respond to a vitality test, as verified by the patient's dentist, who carried out the root canal therapy on this tooth.

CASE 49.—The patient was operated on twice, the second operation being performed one year and eleven months after the first one, a fistulous opening developing in the region of the first operation. Root-canal therapy was again instituted in the upper right central incisor, and now two years have elapsed since the second operation. It was assumed at the time of the second operation that the root-canal therapy had been incomplete the first time. The tooth at the present time is firm and serviceable.

CASE 50.—The patient had undergone orthodontic treatment for three years prior to discovery of a large cyst over the upper left incisors and cuspid and chronic apical pericementitis affecting the upper right lateral incisor. Orthodontia was discontinued after the operation because the patient was prone to believe that the orthodontic treatment was the cause.

CASE 52.—The patient presented an acute pericementitis of the upper left bicuspids sometime after root-canal therapy was instituted. The operation was performed under conductive anesthesia and the teeth were successfully amputated despite the fact that the condition was in the acute stage.

In Figure 6, a short description is given of root amputation performed in my own mouth in January, 1906. Lester R. Cahn was kind enough to section the apex of this tooth, a microphotograph of which is seen in Figure 7. Dr. Cahn forwarded to me the following description of the section: "The specimen was an upper bicuspid tooth that had been fractured in the mouth. There were two parts and the apex was missing. The larger part, containing most of the apical portion, was decalcified and embedded in celloidin. Sections were made and stained with hematoxylin and eosin. The section showed a tooth with the apex missing. Laterally, the peridental membrane was intact and showed no evidence of inflammation. The stump of the root was irregular and was covered with a thin fibrous tissue which showed no inflammatory reaction. There were a few Howship's lacunae occupied by osteoclasts. The latter phenomenon might have been due to the fact that the tooth had been fractured and the trauma had recently started an osteoclasia."

The foregoing can only strengthen one's belief in the usefulness of the operation with the study of which this paper deals.

CONCLUSION

I should like to say again that I not only have had a varied experience in using this operation, but I have also had the operation performed on myself by a general practitioner. The tooth, a maxillary bicuspid, remained a useful member of my masticating apparatus for twenty years, when, through some unfortunate mishap, the root was split and had to be removed. I consider the retention of a root for such a long period a most desirable accomplishment. Let me repeat that I believe root amputation to be a procedure which can be highly recommended and that as long as we believe in root-canal therapy, we must perform root amputations in selected cases because root amputation is nothing else but root-canal therapy plus surgery.

101 East Seventy-Ninth Street.

DISCUSSION

A. B. Vastine, Danville, Pa.: Dr. Blum approaches the question of root amputation from an angle of vision different from mine. His approach is from the point of view of preservation of the function of the tooth or teeth and as one who teaches and performs this operation and looks at it more closely from the mouth alone than I do. This is not meant as a criticism so much as a statement of our respective positions. I am called on to review the end product of all types of dental service in a clinic where patients come to us suffering from the various stages of focal infection and associated maladies. The preservation of the whole bodily function, therefore, must needs be a paramount achievement. As I sat here and reviewed the films submitted by Dr. Blum, a recent case history came to mind which suggested, incidentally, that a study such as this is futile unless full mouth pictures are submitted. Often, these are inadequate even when a complete clinical and laboratory survey is made. Infectious reactions may extend through the medullary cavity from the floor of the nose to the tuberosity, or through the mandible bilaterally. The inadequacy of the single film as evidence is obvious. Mrs. F. E. S. was supposed to have gallbladder and colon trouble in 1914. Operation for floating kidney was performed two years later, with tonsillectomy at the same time. The apex of the upper left lateral incisor, the only pulpless upper tooth, was excised. Two operations were performed for spur and recurrent spur in the floor of nose, which has again recurred. Pain, "neuralgia," in the left side of face with lethargy and fleeting neuritis suggested that the patient have the teeth examined before having another operation on the septum. There was one tooth with the apex excised in the left maxilla, with the root canal well filled and no evidence of reaction about the root, except a faint outline about twice the diameter of the root itself, and, on the right side of the septum in the floor of the nose, a more dense area of bone than on the left side. The maxillary films suggest a very thin bone, while clinical examination revealed an alveolus of average dimension. Cystectomy was performed in the left maxilla. There was a definite medullary involvement including the whole area from the median line to and including the tuberosity and the floor of the nose. The nasal boundary was involved in an area of condensing osteitis which connected at the base of the septum with a spur which was cleared. It was difficult to tell whether the medullary infection had its origin in the tooth from which the root-apex had been removed or from a previous ineffective removal of the infected teeth as the upper left second bicuspid and second and third molars were missing. Three pulpless teeth were removed from the mandible. They showed a bilateral involvement of the vulnerable area of the mandible. After apicoectomy has been performed, the tooth must be regarded as a bacterial habitat unless it is from time to time proved otherwise. To meet this test is a difficult matter. These teeth must have been at least a potential focus of infection; or why the apicoectomy? The focal mechanism in the form of a cyst, condensing osteitis or osteitis is eliminated at the time of operation. When a new vulnerable resistance mechanism is erected or when a direct invasion may occur from this potential source of infection, we have no accurate way of measuring. It all hinges on that imponderable thing, general resistance. The human race has survived many ills, and I have no doubt that owing to the necessarily limited field of application for the required operation, it will survive apicoectomy.

M. Hillel Feldman, New York City: I wish to speak a word in commendation of the technic of root amputation both from the standpoint of the mechanics of the operation and from a consideration of its necessity in conservative surgery as practiced by Dr. Blum. Dr. Blum made a very successful resection of a left maxillary incisor for me fourteen years ago. If Dr. Blum had completed his records of my case and included it with those which he reported to you, his successful cases would number 160, because a roentgenogram taken recently showed the bone completely formed up to the resected apex. I feel gratified that Dr. Blum has in the last few years discarded the use of the chisel and mallet and is using the drill for the resection of apices. I have always felt that chisel-mallet force was unnecessarily harsh from the psychic point of view, and I was using the drill even before Dr. Blum was for this operation. I venture the hope that Dr. Blum will see his way clear eventually to use the drill as I do in other parts of the mouth for operations other than resections.

George W. Christiansen, Detroit, Mich.: Many of Dr. Blum's roentgenograms show

apparent regeneration of membrane and lamella. I carried a pulpless central incisor for a number of years, and during this time, I constantly had a mild conjunctivitis, which frequently became very marked. Roentgenograms, made at least twice yearly, failed to show even a thickening of the pericemental membrane and naturally no change whatever in the dura. This tooth was removed under the most aseptic conditions and cultured by one of the best pathologists in Detroit. Growth showed an almost pure strain of *Streptococcus viridans.* If such a condition can exist with no break in the pericemental membrane, why should Dr. Blum believe that the apparent regeneration of these structures, after their loss through bacterial action shows a clearing up of the infectious condition?

Guy R. Harrison, Richmond, Va.: Dr. Blum's percentage of successes is very much higher than it would be in most cases. He uses the term "root amputation." Would not the term "resection" be more descriptive? Or we might qualify the term "amputation" (i.e., "subtotal amputation") rather than to use the term "root amputation," creating the impression that it is *in toto.* If a root was resected or removed in its entirety, amputation of the cervix would be correct. I would like for Dr. Blum to stress in his closing discussion the indications for this operation. I think that, many times, root resections are performed when proper pulp canal therapy and treatment, treatment and filling of pulp canals being absolutely essential, plus transalveolar surgery would obtain the same result. I feel that there is a tendency to rush into root resections when probably transalveolar surgery, plus the primary root canal treatment and filling, would assure the same results. He spoke of the fact that, in his opinion, the operation had best be done by the specialist. I object to the term "specialist." We should remember that ability does not of necessity rest upon the escutcheon of so-called specialists, neither does it of necessity reside in metropolitan areas.

A Member: Dr. Blum, if a patient was in good condition when the operation was performed, if a heart condition developed afterwards or an arthritic condition, or any of these conditions, and no other direct cause for the condition was found, would you remove the teeth that are shown to be in good condition or would you leave them as they are? Dr. Blum puts it very nicely when he says "if the cases are carefully selected." I feel that as in all other operations in the dental field, there is a field for these operations, but I think that the cases must be carefully selected, and in the case mentioned just a few moments ago, I think that Dr. Blum, as any other thinking man, under the conditions would remove the root that had been amputated.

Dr. Blum: Dr. Vastine accuses me of thinking only of the function of the teeth, only of preserving the tooth. I thought I had made it quite clear that we operate only in selected cases. Whether the case is selected from a purely dental point of view, whether the case is only selected on account of the peculiar general condition makes no difference. The case is selected. I said that the patient must be in good health, that we will not further overburden a general system which is already diseased and overburdened. That answers all of these questions as to whether I perform an amputation when the patient has a heart lesion or rheumatism, etc. Of course not. I would not think of it. If I did that, I could probably report 1,500 cases instead of 159; but it is indicated, in my opinion, in selected cases. I am not trying to influence anybody. I am just giving facts from my own cases. There is a place, a distinct place, for this work, provided you believe in root canal therapy. If you are radical and do not believe in root canal therapy, let us not discuss this at all. Dr. Vastine thought that I should have shown full mouth films of all those cases. If you do not believe the statement that the patient's mouth was in good condition, I could show you anybody's roentgenograms, so you will have to take that for granted. But that is not the question. You may ask me to bring the patient here, to submit the patient. That would be best and then you could see for yourself. As you know, it is very difficult and practically impossible to show a full mouth film on the screen in one view, as it should be viewed and learn anything from it. Regarding the spur in the nose, due to an amputated incisor probably, of course I cannot answer that question. If the case had been examined before the root amputation, maybe the spur would have been found there at that time. Of course, there must be a reason for cutting off the apex of the tooth. Otherwise, we would not do it. About the chisel and mallet for use in amputating the apex: We practically always use the bur and not the chisel,

but we were working for some time in the hospital where they had no engine at all and we had to use some other means. It was, I think, very foolish to use the chisel. If you recall the histologic makeup of the root, you will understand that you are taking a chance in trying to use a chisel in amputating the apex. It may run in almost any direction, this depending on the direction of the dentinal tubules. Someone asked me to explain the presence of streptococci at the apex of a tooth which, I understand, was not amputated. He has repeatedly suffered with inflammation of the gingiva. How he can expect the apical region not to become infected if the gingiva has been for years attacked by infection, I cannot see.

Dr. Christiansen: I said conjunctivitis, not gingivitis. The gingiva was entirely normal, as was the apex roentgenographically, over a period of five years.

Dr. Blum: That I cannot explain. Dr. Harrison would like to suggest a better name for root amputation. I am unable to give new terms to operations or tissues. So many other men are very able in doing that and I will leave it to them. I was brought up on the term root amputation. There is a man in New York who uses the term "transalveolotomy." I do not know what it means. Does it mean cutting an alveolus without cutting off the apex?

Dr. Harrison: Yes.

Dr. Blum: I never cut away or remove just the bone and soft tissue without cutting the apex because I feel that if there is the indication for an operation, it is just as well to cut off the apex, as I said in my paper, and be sure that that part which may be pathologic is removed. Many years ago, even in my short years of experience, I said that it does not make any difference whether one is a D.D.S. or an M.D. or both; what he needs in order to practice is knowledge and experience. The law provides for degrees because we must have some order. Degrees have been created so that a man will have the fundamentals for practice. I know, and so do you, that some of our best metropolitan surgeons have only one degree; and I know of others who have an M.D. and a D.D.S. and what not, and I would not permit them to operate on me. Now whether you call them specialists or general practitioners or whether you call them nothing is also immaterial to me; but otherwise how would the patient know where to go? Specialists have been recognized by both the medical and dental profession. My judgment of a man is not based on where he practices, whether he is in a big city or a small city. Regarding heart lesions or kidney trouble or what not in a patient: I have answered that before. There is no indication at all to overburden a system which already has been weakened.

A Member: I asked whether, if these conditions developed after the conditions shown in the slides, after the filling in, and no other direct cause could be found, you would leave those teeth in or remove them.

Dr. Blum (closing): If such a condition develops and everything has been tried to eliminate it, every pulpless tooth would have to be removed, which naturally includes an amputated tooth. I have tried to show that root amputation, or whatever you may call it, is still indicated in selected cases and from my own records I feel that I will continue to perform this operation until I am convinced that it is contraindicated.

DENTAL ECONOMICS*

By JOHN C. WARNOCK, D.D.S. Kansas City, Mo.

DENTAL economics and dental ethics are two conspicuous and important subjects, productive of much controversial discussion whenever and wherever dentists are assembled.

At this time, I shall not attempt a discussion of ethics, except wherein dental economics and dental ethics are so intimately intertwined that they cannot be dissociated.

"Economics is the science which investigates the conditions and laws affecting the production, distribution and consumption of wealth. It is the material means of satisfying human desires. An economist is any one who is a manager of affairs, especially one who manages a concern with frugality or one who expends or directs the expenditure of money, time or labor, judiciously and without waste."[1]

Briefly, economics is the science of business efficiency, whether applied to commercial pursuits or to professional activities. Obviously, dental economics is the science embracing the principles of business efficiency as applied to the practice of dentistry. It is equally obvious that every dentist should be an economist.

We are living in an economic era. We must not only recognize this self-evident fact, but we must also prepare ourselves for adaptation to economic conditions as they exist, at this time. Economic problems confront us in every walk of life, and at every turn. The practice of dentistry does not, in any degree, confer upon us an immunity to financial disaster, which is the inevitable result of inadequately meeting our daily economic problems.

To enter dental college; to assume the responsibilities of matrimony; to manage a home; to educate a child, all involve numerous, complex economic problems. Most assuredly, the modern, successful practitioner of dentistry must possess not only the highest professional qualifications, but also an ability accurately to appraise material, skill and time. In other words, the modern successful dentist must be a man thoroughly trained, both in the professional and in the intrinsic business principles which constitute modern dentistry.

A successful dentist must of necessity be a good business man. The dentist pays rent; employs assistants and others to conduct his office; purchases material; sells a commodity; borrows money; has a checking account, and performs the usual functions and meets the usual obligations of any other business man.

"The practice of dentistry as ordinarily pursued, the delivery of service and product for a price, is a business, pure and simple; therefore, the ordinary practitioner should understand business principles and systems; should know that he

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1. Webster's New International Dictionary.

occupies a place in the commercial world that he cannot honorably fill, unless he follows the rules in the realm of commerce, protects his creditors and his family, and aims toward the assurance of financial independence."[2]

A dentist can, with propriety and dignity, invest in any business enterprise of his choosing. He can indulge his sporting instinct or his desire for monetary gain by playing the stock market. He can, without jeopardizing his ethical status, bet on the result of the "World Series," a prize fight or a horse race. He can even play poker for whatever stakes his financial ability will permit, and do so without committing an ethical breach.

If a successful dentist, prompted only by a sincere desire to serve the best interests of his fellow practitioners, is sufficiently frank to explain, in detail, the method of procedure whereby he has been able, by the adoption of economic methods, to live well, to educate his children and to save enough money that he can feel assured of freedom from financial worries when the infirmities of age come upon him, should he be accused of commercializing dentistry, of having committed an ethical sin, and be threatened with professional ostracism?

The oldest profession in the world, probably, is the practice of medicine. Since its founding and the formation of a code of ethics to govern its activities by Hippocrates more than 400 years before Christ, this grand old profession has been steadfastly characterized by genius, intellectuality, dignity and a reverential regard for ethical deportment.

The economic aspect of the practice of medicine is, at this time, receiving the most careful, thorough and serious consideration by our colleagues, physicians and surgeons whose professional qualifications and affiliations amply justify their leadership in the American Medical Association. This statement is conclusively evidenced by a perusal of the official publications of the American Medical Association.

I shall quote some pertinent observations made by Dr. Follansbee,[3] of Cleveland, Ohio, a member of the Judicial Council of the American Medical Association. "The application of ethics in medical practice has changed with the times, following the general trend of moral standards. There is much misunderstanding of the term 'medical ethics.' This is not confined to the laity. Ethics may be defined briefly, but it seems to me plainly and comprehensively, as 'the basic principles of right action.' In a word, it is incumbent on the physician that, under all conditions, his bearing toward patients, the public and fellow practitioners should be characterized by a gentlemanly deportment, and that he constantly should behave toward others as he desires them to deal with him."

M. L. Harris, of Chicago, chairman of the Judicial Council of the American Medical Association, has contributed a praiseworthy article which he has captioned "The Economic Value of Medical Services." In this paper, Dr. Harris states: "In order that the profession may fulfil its undisputed duty, it must organize on a business basis." Dr. Harris further states: "We may define value, in connection with medical services, as depending on their utility or their fitness to satisfy human needs or desires. In this connection, value may be viewed from the standpoint of those who receive the services, and from that of those who render them. There is a difference be-

2. Kent, E. N.: The Business Side of Dentistry, p. 174.

3. Follansbee, G. E.: A. M. A. Bull., 23 (June) 1928.

tween human need and a desire. There are varying degrees, therefore, to value as applied to medical services, depending on these factors."[4]

William Allen Pusey, of Chicago, an ex-president of the American Medical Association, has contributed an exceedingly worthy though somewhat revolutionary article the title of which is "Some Tendencies in the Business of the Practice of Medicine."[5] Following are exact quotations from this courageous and reputable author: "I have thought that it might be fitting to consider some of the problems of our profession as a bread and butter occupation. I am proposing, this evening, to consider certain tendencies that are developing in what, for lack of a shorter or better title, I call the business of the practice of medicine. I am using the word 'business' advisedly, meaning by that the occupation by which we make a living. Some of my friends take deep offense when I use the word business in connection with the practice of medicine, contending that the doctor's calling is so far above business that it is a reflection to use that term in connection with it." Dr. Pusey further states that the American Medical Association is considering the establishment of a bureau to consider the economics of medicine. "This, in my opinion," Dr. Pusey says, "is a wise step."

For the past two years, authoritative medical literature has been teeming with advice to physicians everywhere to adapt the principles of economics to their professional lives.

We have, after careful consideration, selected dentistry as the means of acquiring the necessities of life, along with whatever of the luxuries our competitive ability will afford us. It is unquestionably true that we prefer our profession above all others as a means of securing a livelihood. Is not that sufficient justification for our choice of vocations?

The men who persistently insist that they practice dentistry primarily because of the unusual opportunities afforded them thus to serve the urgent needs of humanity have done more to cause the finger of derision to be pointed at us than have the entire ensemble of high-binder artists who utilize dentistry to extort exorbitant fees from a gullible public.

In my opinion, the man who elected dentistry as his life work and was prompted in so doing only by altruistic and humanitarian motives is a unique and exceedingly rare specimen.

Modern dentistry has participated abundantly in the world-wide prosperity of today. If your own business has not become an integral part of this general prosperity, something is fundamentally wrong either with you or with your environment. If your environment is wrong, the sooner you change your location, the better. If the more probable contingency exists that you are attempting to adapt procedures, either professional or economic, of a generation ago to present requirements, you are taking upon yourself an unattainable task. You are not only closing your door, but you are also securely locking it against the entrance of prosperity.

To attempt today to conduct a dental office successfully, while harboring a traditional antipathy to modern economic methods is as illogical as it would be to attempt to utilize only the heritage of dental procedures, bequeathed to us by a revered but bygone generation of dental pioneers.

To make a practical application of economics to a dental practice entails

4. A. M. A. Bull. 24 (June) 1929.
5. Pusey, W. A.: J. A. M. A., 90 (June 9) 1928.

exactly the procedures required to put any other enterprise on a sound business basis. It is an uncomplicated and entirely sensible business procedure that will develop a mental attitude enabling one to better sense the real worth of dentistry; it will expedite the work; it will increase efficiency; it will eliminate many difficulties; it will enable one to face facts and deal more adequately with them, and it will be a guide in the application of sound business principles to financial problems.

We shall then be able not only to render a better service, but also to care for a larger number of patients, in a given time, in a manner more satisfactory both to the patients and to ourselves.

In any business transaction wherein a profit is involved, the cost of production should be known. Dental economics teaches us how to estimate accurately the exact cost of production, so that an equitable fee may be charged.

The chief of the several factors entering into computation of the value of dental services is time. I shall purloin a clause from legal phraseology and state that time is the essence of value in computing dental fees.

Modern dentistry is rapidly becoming an exact science. There is no longer an abiding place in real dentistry for conjectures, suppositions and approximate measurements. The building of a denture, the preparation for a porcelain jacket, the construction of an inlay or even the preparation of a cavity for an alloy requires an ability to take exact measurements, to make accurate calculations and to form correct judgments.

The efficient performance of these procedures, as well as the accomplishment of the numerous other requirements incident to the practice of dentistry, requires the expenditure of much valuable time, the one outstanding and all important factor, which enters abundantly into the value of the completed and perfected product. Yet time, in the average noneconomic dental office, if reckoned with at all, is minimized and dwarfed into insignificance.

The estimated average life of a dental practitioner is only eighteen years. The mere statement of this cold fact should be sufficient argument to curtail our injudicious giving away of time, the most valuable asset which we possess.

The real dentist has little other than one commodity to sell. That commodity is health service. Dental health service depends largely on time as a measure of its value. The sale of gold and other material is only incidental to the activities of the real dentist.

It is only logical to assume that when dentists consider and compute time with some degree of accuracy, prevalent criticism, both of the large and of the small fee, will be, to a great extent, eliminated.

The fee for any case should be based on the time consumed, the skill and responsibility involved, the financial status of the patient and the measure of service rendered.

When we consider that out of 365 days of the year, we must subtract fifteen days for vacation, fifty-two Sundays, thirteen holidays, four days for illness, one-half day each week for recreation, or twenty-six full days, and five days for dental meetings, we have left only 250 working days in the year. By the careful use of the time stamp, in many thousands of offices, it has been found that four productive hours each day is the maximum available time; which indicates that there are just 1,000 productive hours in a year.

To arrive at the cost of production for each hour, in any office, divide the fixed

overhead expense by 1,000. The overhead expense comprises rent, light, electric power, telephone, salaries, drugs, office supplies, and laundry; depreciation, obsolescence, replacements; interest on investment, taxes, insurance and all other expenses incident to the maintenance of an office.

If our expenses are more than 33⅓ per cent of our gross income, we need economic help. When a dentist is ill, he consults a physician; when his teeth need care, he consults a dentist; when his business needs attention, he should consult an economic specialist.

The statement is frequently made that the public has always been willing to pay a fair price for what it needs or wants, but this same public will protest at paying a fair price for a commodity without first understanding the factors which govern the price. Certainly the dentist cannot retain his poise, dignity or professional attitude while rendering a service at a price either too low or too high, and for which there is no conceivable justification which can be supported by figures or by reason.

There are four distinct erroneous methods in vogue, at the present time, of establishing dental fees; undercharging, overcharging, guesswork and charging all that it is possible to charge without arousing a protest.

Thirty-three years ago, I entered dental college. At that time, dentistry had only begun its meteoric ascent to the lofty plane which it occupies today in the professional world. A dental college education could then be acquired in three years. The enrollment and qualification requirements were pitifully meager. The annual tuition was $150.

Since that time, I have had an opportunity to witness the marvelous evolution of the dental college, and I have the cherished privilege of being one of the component parts of a modern dental college.

Many of our dental colleges throughout America have recently established a department of economics. I hope and I believe that, within a very few years, every dental college in our land will have incorporated in its curriculum the most important dental innovation of the present decade, a chair of dental economics, presided over by an adequately trained, thoroughly experienced and obviously successful dental economist.

I am thoroughly convinced that the great majority of financial failures in the dental profession are not the result of inadequate professional training, but rather are the direct result of an insufficiency in or a total lack of economic training, and the ignoring of the fundamental principles on which every successful business is built.

When I was graduated from dental college, I had not the slightest idea as to what constitutes a just and equitable fee. The amount of the fee decided on and named usually depended on three factors: the amount of my courage, my immediate financial need and my guess as to what the patient expected to be charged. My lack of economic training was, in no way, exceptional.

Is it any wonder, then, that so many professionally efficient dentists, as a last resort, to avoid financial disaster have embraced the readily available alternative, advertising?

It is not difficult to understand why so many dentists cannot afford to equip and to maintain good offices, why they cannot own automobiles; why they cannot live in homes of their own; why they cannot send their children to college, and why they cannot afford to belong to their

local dental societies or to attend educational conventions.

Every professionally competent dentist should be permitted, without question or criticism, to sell his services at a legitimate profit, and without fear of being accused of commercializing dentistry or of exploiting the public.

To sell dental services at a profit demands a complete and an accurate knowledge of cost. An understanding of cost can be acquired only through comprehensive knowledge and a keen appreciation of each one of the various factors comprising it. Every constituent factor of cost is important; the prime and dominant one is time.

If we will strive earnestly to understand the cost of production, and add thereto a legitimate profit; if we will classify our patients with regard to their needs, desires and ability to pay for dental health services and if we will name our fees in advance, with a definite understanding of the exact methods of payment, there will be many more successful dentists, judged by the standard of professional and financial success, and as a consequence, dentists will give greater value to their patients by preparing themselves to render more and better health service.

Not only will dental economics then be vindicated, but it will have been proved, to the complete satisfaction of every one that, rather than commercializing dentistry, dental economics has stabilized and standardized it.

810 Lathrop Building.

DISCUSSION

W. Ray Montgomery, Buffalo, N. Y.: Dr. Warnock has made a strong, rational plea for economics in dentistry. Let us hope that, with clearer understanding, it may result in a lessening of the prejudice which seems to be held against this important subject. So often in the discussion of economics, we hear the plea that ethics be taught instead of economics. These are two distinct subjects, and when correctly understood and applied, should be no more in conflict than are ethics and operative dentistry, or any other subject which, through its misuse, may do great harm. Dr. Warnock has quoted the definition of ethics as "the basic principles of right action." Let these principles be instilled into the student until they control his habit of thought and enable him to discriminate between right action and wrong action. Teach him to put himself in the place of the patient in making his decisions and, with this broad ethical foundation, let him organize his office on a basis which is economically sound. He will have a great advantage in drawing and holding a valuable clientele, gaining its respect and acquiring a competence. All work which may properly be done by others should be delegated to one or more assistants. Books and records simple enough for an assistant to keep, yet so comprehensive that the dentist may determine accurately his costs, as well as the state of his income, should be provided. This system should provide a checkup on all free service rendered, so that the dentist may have information regarding the leaks. Little things that taken singly seem so trivial, in the year's aggregate may mount to surprising figures. The ideal system will also include provision for the recall of patients at regular intervals in order to keep them constantly under observation. By this means, the unproductive group of services can be practically eliminated, and, with us, it has nearly solved the pulp canal problem. During the past year, it has been my privilege to study the methods employed by three of the most outstanding dentists in this country in conducting their practices, men who are not only successful in practice but stand also at the head of the profession for integrity and high ethical conduct. I was not surprised to find that these practices were smooth running organizations whose system was based on sound economic principles. Fees were not exorbitant but carefully arrived at. The dentist was relieved of all clerical detail and annoyance, to devote himself to productive service, and the leaks were stopped.

Whether consciously or unconsciously, these men have each developed a high order of salesmanship, to employ a commercial term. I questioned all three as to whether there was conflict between the principles advo-

cated here today by Dr. Warnock and their own, and there was not. Not the least of the economic problems confronting the dentist are those concerning checking up on new patients, to determine their credit standing, and the collection of delinquent accounts. In smaller places, where everyone is known, this is not difficult, but in a large city, it is often a problem. About seven years ago, a group of Buffalo dentists under the leadership of W. W. Cavers formed a membership corporation which they chose to call the "Buffalo Professional Men's Credit Bureau." Both the medical and dental professions were solicited for members. These members pay a moderate annual membership fee. The officers consist of a board of directors and a paid executive secretary, who employs what additional office help she needs. Each new member is required to submit a list of patients who, for any reason, he feels are undesirable. He is also encouraged from time to time to submit supplementary lists. For some time, lists of names thus submitted were sent to each member, but recently this practice has been discontinued, and the members are encouraged to call the office to inquire of the secretary concerning anyone about whom they wish to know. If she has the person listed, she gives the information. She is also in a position to act as a go-between for the new man and the doctor who listed the name, without either being known to the other, and learning just what the difficulties have been. If she has no information, she makes every effort to secure a rating. She has as sources of information the retail merchants association, the banks, employers, etc. On receiving these data, the inquirer is perfectly free to do as he choses about accepting the person as a patient, but he acts with his eyes open. Each member is supplied with an insignia which reads "Member Professional Men's Credit Bureau, Inc." This is embossed on a card 6 by 8 inches in size covered with glass and set in a neat frame. It may be hung prominently in the office. It is not objectionable in appearance, and serves as an added protection. Some time after organization, it was decided to add a collection service to the bureau. Accounts are accepted from members for collection on a percentage basis. Every effort is made by the secretary and her staff to collect. If she fails, the account is turned over to the attorney for the bureau, who threatens suit. At this point, the member is consulted and a summons served, or the matter is dropped, as he wishes. Every effort is made not to give undue offense and to keep the goodwill of the patient as far as possible. Results have been gratifying. The idea of the professional men's organization seems to have weight, and in many accounts which have resisted every effort, collection follows on the first letter from the bureau. A rubber stamp is also furnished to members which reads "If not received by.....date, your account, which is long past due, will be turned over to the Buffalo Professional Men's Credit Bureau for collection." This may be used on a statement before it is turned over for collection, and often brings results. The names of all debtors whose accounts are received by the bureau are listed in its files, so that the collection service also furnishes another source of supply to help swell the lists. To make such an organization a success requires a great deal of work by a few men, fair support by the membership, and a secretary who has intelligence, tact, a great deal of energy and an understanding of professional relationships. In her calls from office to office to collect membership dues, lists of delinquents and accounts for collection, she is made to realize the great need of economics in dentistry.

Edwin N. Kent, Boston, Mass.: It is unfortunate that it is necessary to devote several preliminary passages in such a paper to an argument as to the consistency and ethical stand of the writer in presenting the subject. If we gain nothing else in the present discussion, let us arrive at the point where we may consider the dentist's business relations with the public without the further necessity of introductory excuses. I am not blaming Dr. Warnock. Those of us who have made bold to enter this dangerous field in the past have always thus built up such an armor of defense before we began the delivery of our message. (It is high time that we, as a profession, go on record as recognizing the consideration of this subject as one of our professional and public duties and I personally indulge the hope that we may, at this time, do something toward the attainment of this result.) The situation is due entirely to a distortion of ethical principles and theories by those impassioned but unreasoning members of our profession who mean right but reckon wrong; who, because they see the danger of too many steps in a certain field, would post a sign on the fence prohibiting admission.

Those of us who have given much thought to the subject before us fully realize the danger of the field, but we also recognize the fact that we, as thinking adults with reasoning minds, must enter many dangerous fields. It is said that the greatest enemies of religion are born within its own fold. It is thus with professional ethics. Ethics is, briefly, "the science that treats of the principles of human morality and duty" (Webster) or, as Dr. Warnock has quoted, "the basic principles of right action." If some of our ethical enthusiasts (to designate the group with a mild caption) would give a bit more of their thought to the inclusive term "general ethics," before they advance theories on the narrower term "professional ethics," they would perhaps reach the conclusion that some of us have reached—that the "basic principles of right action" involve a consideration of dependents and creditors as well as of patients. If I may be excused for using a quotation from the preface of my book, the dentist "may follow a code of professional ethics that will fill a volume and, breaking the standard rules of commerce and finance, he is unethical still. (A person who follows slipshod methods in the realm of barter and trade is a positive injury to the community in which he operates. He is not a good citizen, and it is more important to be a good citizen than a good dentist.)" One gratifying point about Dr. Warnock's paper is the fact that he has confined himself strictly to the subject in hand. Dental economics is but one phase of the business side of dentistry. The development of magnetic personality, attractive environment, ethical appeals for extension of patronage and other items in connection with the psychology of professional success, interesting as they may be to those of us who are analyzing the broader problems of profitable practice, are not within the scope of the present discussion. I have been immeasurably aided in my work at Harvard by the dean and other members of the faculty of the Harvard Graduate School of Business Administration. Their regular departments of research, as well as special committees, have been delegated by the dean to assist me, and they have shown an encouraging interest in the work. This great institution, with an endowment of several millions under the Baker foundation, has, as you know, for its special mission the professionalization of business. They are broadcasting the seeds from which will grow the professional principles of unselfish service in all lines of trade. It is a significant fact that they, with their high ideals and purposes in this direction, recognize the concomitant need of a limited and cautious commercialization of the professions. And this with a view to public welfare more than the welfare of dental practitioners. We are facing a serious situation which cannot be ignored by any member of our profession who lays claim to a public spirited attitude. A recent writing from England indicates that the same problem to them over there must be solved here. We are threatened with a shortage of dentists at a time when the demand is materially increasing. It is said that there are 800 less dentists in this country today than there were two years ago. This may not be an authentic figure, but the falling away of dental practitioners to an alarming extent is not questioned by anyone who knows the facts. A part of this lessening of recruits in the dental field is due, undoubtedly, to the increased severity of college entrance examinations and the lengthening of courses; but another item is of greater importance. In these days of increased living costs, the general profits from dental practice are not attractive, and men who, a few years ago, would have entered the profession are going into the more lucrative commercial fields. Note Dr. Warnock's quotation from M. L. Harris of Chicago, chairman of the Judicial Council of the American Medical Association: "In order that the profession may fulfill its undisputed duty it must organize on a business basis." General medicine as well as its branch profession, dentistry, is threatened as an institution unless it is propped up by a more stable financial organization. Obviously, the main fault is with the professional schools in which the need is ignored and men are sent out into practice without the fundamental knowledge necessary to its establishment. I have several times presented the matter in these words: "The average actor could not successfully run a theater; the average machinist is not equipped, mentally, to organize or manage a machine shop. Why should we expect the average dentist to be successful in the management of an institution in connection with which he has only been schooled to supply the labor?" (Not only should the dental schools teach the subject in question but the courses should be as comprehensively organized and as seriously presented as are the

other subjects in the curriculum. And the teaching should be followed by examination.) For several years, no graduate of the dental department of Harvard University has stepped out into his chosen profession without passing an examination which aims toward the determination of his fitness to face the business problems of dental practice. We recognize that there are two distinct departments in every dental practice: administrative and operative, and that complete professional success is impossible without a knowledge of both. We feel that the advancement of dental science, the elimination of oral diseases, the great objects of our profession, are dependent for the most part on the interest, support and effort of men who, in turn, depend financially on the remuneration they receive from the pursuance of dentistry as a business. For the sake of public welfare alone, it is incumbent on us to do what we may to assure the financial success of our graduates. Look over your program of this meeting. How many names will you find among essayists and clinicians of men who are unsuccessful in practice from the financial point of view? High ideals, lofty aspirations, altruistic motives do not thrive well in an atmosphere that vibrates with the demands of the bill collector. There are exceptions to all rules. All honor to those noble souls who have given wealth to the world and passed their own last hours in poverty. But as we raise our heads after paying them homage, let us face the great issue with the determination that such sacrifice and martyrdom shall, in the future, become more rare. Let us believe that God's law of recompense and compensation rightfully involves elements of comfortable living as well as of honor. I cannot add much to the excellent paper to which we have listened. If I am successful in emphasizing one point I will be content. Another quotation from my book is as follows: "Public welfare demands the advancement of dental science. Dental science is, under existing conditions, advanced mainly through the efforts and monetary backing of persons who are financially successful in dental practice. The remuneration that comes to the dentist is, therefore, important to public welfare."

Dr. Warnock (closing): Dr. Montgomery spoke about the credit rating. That is very important. At a meeting in Providence, Rhode Island, of the National Retail Credit Men's Association, the president of that organization, who is credit manager of one of the large dental supply houses in our city, when the subject was brought up relative to admitting the dentist to that organization, put the matter to a vote as to how many of them thought the dentist was qualified in a financial way to become a member of the organization. Only four thought he should be eligible. The president convinced them that dentists were honest men and were handling credits and should be admitted to the credit bureau. Consequently, the dentists were admitted and are now eligible to membership in the credit men's association. Dr. Kent brought out the question of ethics. "Gentlemen, ethics isn't confined to the profession; ethics must cover the laity as well." One of the definitions of ethics is "performing or discharging a moral duty." It certainly is a moral duty for every dentist to be able to provide for his family and pay his honest and just bills. I wish to leave this one thought with you: There is a definite, accurate way in which to carry on a dental practice, and that is to do it on the same kind of a business basis as the banker or business man.

GINGIVITIS: AN INFECTIOUS ENTITY, FROM THE MEDICAL AND DENTAL ASPECTS*

By ROBERT A. KEILTY, M.D., Washington, D. C.

GINGIVITIS is an entity as far as it is an inflammation of the gums and investing structures of the teeth. Primarily, its management is purely a dental problem, but also primarily its recognition as one of the foci of infection and its infectious relationship to other parts of the body is a medical problem. In these distinct but definite spheres, gingivitis presents a cooperative dental and medical problem.

In my work, which goes back more or less continuously to an association with the original report of Smith and Barrett[1] on oral protozoa in 1914, I have been swayed here and there many times, with the infectious side of the question pretty much in the lead. Unfortunate enough to have had a severe attack of acute "trench mouth" in 1919, with exquisitely painful exposure of cementum and dentin and the inevitable development of so-called pyorrhea, with deep dental periapical foci and acute infectious arthritis, I have been, if for no other reason than a purely selfish one, continuously at the study of it. Needless to say, I have had all manners and methods of treatment, from the little bottle with a fancy name but unknown content, to chromic acid, silver nitrate and trichloracetic acid. My teeth have been carefully scraped and all tartar removed on numerous occasions, my acid mouth has been treated by various alkalis, I have, it seems, massaged out ounces of blood with various tooth pastes and have used faithfully all sorts of "pyorrheacides" as dentifrices. I have had my bite and traumatic occlusion corrected innumerable times, always to be told that I still have it. I have had fillings placed since childhood, followed by root-canal fillings, death of pulps, crowns and bridges, to final complete surgical removal, with a partial denture. I even had, some years ago, a partial surgical gingivectomy somewhat after the methods now being offered. In spite of all this my "pyorrhea" continued until the establishment of a definite line of attack against the infections present.

I recite this experience in order to cover the field of effort as presented today by the majority of the dental profession, and in no sense as an indictment. This is the consequence of the very complexity of the subject and the lack of unanimity on the part of the teachers and research workers. There is no subject on which opinions as to etiology differ so widely nor for which diametrically opposite dogmas are held so tenaciously.

This would not make so much difference if it were not for the fact that more

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*Read at the annual meeting of the combined medical and dental societies of Summit County, Akron, Ohio, April 2, 1929.

1. Barrett, M. T.: Protozoa of the Mouth in Relation to Pyorrhea Alveolaris, Dent. Cosmos, 56:948 (Aug.) 1914.

than 90 per cent of our population are suffering. This suffering means not only the loss of teeth, which is bad enough, but also focal infection, with all of its secondary incapacitating sequelae and even death following infection from extraction, which is all too common, when we consider the country as a whole.

In a previous paper,[2] I outlined my approach to the subject from the bacteriologic and pathologic standpoints. I hope that this approach is correct. Undoubtedly, it will take another generation to establish it. The work presented in this earlier paper was carried on in association with A. B. Vastine and included the first 5,000 cases studied. It is often said that the first 5,000 experiences are the hardest, but this rule has not been borne out in this case. The last 1,000 have been many times harder, and I feel now that merely an insight has been gleaned. The cases reported in this paper have been seen in association with a number of men, both physicians and dentists, in Washington. To these men, I am indebted for the opportunity of continuing this most fascinating subject. Necessarily, as each one of this group has held a rather definite point of view, based on his own individual experiences, which have been extensive, it has been necessary for me to consider several different angles. These were previously given consideration, but I now feel were not given sufficient importance.

The problem belongs primarily to the dentist. He is the one to survey the entire field, chart the conditions present, carry out the appropriate and correct treatment and be responsible for the outcome. The physician must recognize and understand the pathologic process present and must cooperate in the cases of focal infection, but must not dictate. It is not the province of the physician to send his patient for a dental roentgen-ray examination, read the films and then refer the patient to an oral surgeon with instructions to have certain teeth removed. He may cooperate, and if he has good reason, based on experience, he may suggest that certain treatment or surgical procedure be employed, but the final responsibility rests with the trained dental diagnostician and the dental surgeon. There are too many dental angles in a given case which the physician knows nothing about for him to be dictatorial as to exact procedures. If surgery is required, the physician should have studied the case carefully and should give the dentist any particular knowledge concerning the patient. This would include the presence of such conditions as bleeding, purpura, anemia, diabetes, nephritis, syphilis or myocarditis; in fact, anything having a bearing on the oral problem.

On the other hand, the dentist must confine himself to the dental problem, which is comprehensive enough; must be conservative, and must not suggest further extra-oral procedures except in close cooperation with the medical man. I do not believe, as has been suggested by some, that the dentist should make blood counts and urine analyses, examine the heart and lungs or carry out other clinical medical procedures. Since my opportunities to see both sides of this question from an impartial point of vantage have widened, sensible cooperation on conservative grounds appeals to me as a desirable way of handling the situation.

The roentgenologist stands in a rather unique and difficult position as far as the mouth is concerned. If by training he is a dentist, his opinions are valuable; if by training he is a medical man,

2. Keilty, R. A.: Present State of Our Knowledge of Gingivitis. J. Lab. & Clin. Med., 13:451 (Feb.) 1928.

unless his experience has been wide, his opinions are likely to be erroneous. If by training he is neither a dental nor a medical man, he had better stick to his profession as technician and make good pictures without interpretation. The infectious side of the problem is so important that I am trying to interest the laboratory men in a more careful consideration of dental bacteriology than the mere reporting of Vincent's smears positive or negative or the isolation of a few plates of streptococci, with the statement that these organizations are present in all mouths anyway. There is a wonderful chance for cooperation, which both the dentist and the clinical pathologist are missing if they do not get together. Thus, the oral problem as a whole is a cooperative one for the general dentist, the dental diagnostician and oral surgeon, the internist, the roentgenologist and the laboratory.

Gingivitis may be defined as an acute or subacute chronic inflammatory reaction in the gums, and soft investitures of the teeth, progressing, unless checked, to periostitis and osteitis. It is characterized pathologically, and objectively with variations, by redness, edema and swelling, surface granularity, ulceration and suppuration and the establishment of deep gingival sulci. Terminally, loss of teeth ensues. It is often characterized subjectively by nothing; at times, by extreme pain and tenderness in the gums and jaws, with teeth grinding, and more often by bleeding, bad taste in the mouth and foul breath. Indeed, many of the objectionable breath odors are due to the gaseous production of gas-forming cocci in gingival pockets. Thus, gingivitis, all forms of inflammatory reaction in the gums, is inflammatory and as such is infectious in origin.

The term "pyorrhea" has been discarded for reasons[2] which have been considered sufficient. The term "Vincent's angina" has also been discarded, and the general term "gingivitis" or "gingivoperiodontitis," with modifications describing the conditions present in a given mouth, substituted. We would consider all inflammatory lesions of the gingivae and their contiguous structures, whether they be trench mouth or pyorrheic pockets, as one and the same process, gingivitis, under different manifestations.[3]

It is thus my contention that all forms of inflammatory changes in the gums are primarily infectious in character and that the local manifestations — congestion, edema, redness, sulci and exudate, ulceration, recession, pus and pockets, sensitive dentin, dentin caries and loose teeth—all belong to the same chain of infections with variations as to severity, type of infection, duration of the disease and amount of involvement. Many other factors are contributory, and in a given case may be initiating and actually causative, but the infectious element is predominant.

Gingivitis is a progressive disease starting with slight symptoms or with a wide and extensive involvement as an acute reaction. The termination is about the same, advanced loss of structure both gingival and bony, and eventually loss of teeth.

If infections play an important part in gingivitis, what of the other factors which may be present? In the minds of most orthodontists, malocclusion and trauma are the important factors. I am convinced that most mouths show a cer-

3. Keilty, R. A.: Gingivitis II. Clinical Appearance of the Gingiva in Different Forms and Stages, J. Lab. & Clin. Med., 14: 481 (Oct.) 1928.

tain amount of traumatic occlusion and the bite on certain teeth mechanically is producing a localized reaction in and about the teeth involved. When this is all removed and corrected as nearly as possible, after months of treatment, the infectious factor is still present. While a mouth is, in spots, greatly improved, the condition as a whole is not relieved, and gingivitis progresses. When the correction of malocclusion is supplemented by the elimination of infection, as far as possible, in spite of any remaining points of trauma the general progression of gingivitis is checked. I know that the men most interested in this phase of the work would like to argue for hours on this point alone, and the firm fixation of opinions plus the present-day teachings may be cited as one of the reasons for my considering a full generation necessary to straighten out the whole complex subject.

A paper by Willett[4] on "Intercepting Certain Types of Malocclusion," is certainly a step in the right direction, but if all the cases of malocclusion in the world were to be completely corrected at one sitting, progressive gingivitis with loss of teeth would eventually go right on.

Much attention is being directed to the influence of systemic conditions on the production of dental disease as a whole, but more especially to gingivitis under the name "pyorrhea." In my student days, attention was directed to sordes on the teeth, but this was accorded about the same importance as a coated tongue. During the past twenty years, this point of view has changed, and now the influence of systemic disease is by some strongly suspected as a causative factor in gingivitis. If the accumulation of exudate about the necks of teeth is a result of systemic disease, that exudate which favors a rich bacterial flora may be said to be causative of gingivitis. But the problem is not so simple. Attention has recently been devoted to vitamin deficiencies, with blood calcium and phosphorus ratio[5] as having an important part in the etiology of dental disease. While I am certain that changes in the calcium constituent of bone surrounding the teeth, either increased or decreased, is an important factor, and in addition might favor the entry and growth of microorganisms, I am sure that atrophic and hypertrophic bony changes alone are not explanatory of the process which we see as progressive gingivitis and periodontitis. Therefore, systemic disease, vitamin deficiency and changes in calcium content *in situ* or in the blood are predisposing but not predominant causative factors in gingivitis.

Neglected mouth hygiene is often given as a cause, and indeed one of the most advanced cases that I have ever seen was in a man who had not brushed his teeth for two years because of tenderness (exposed dentin) and bleeding. However, I have seen just as severe cases of gingivitis in which the patient employed religiously all the usual types of mouth care. My first work was mostly among tenant farmers whose hygiene was good, but not excellent, and I was a little fearful that because of conditions, the widespread incidence of gingivitis might indicate a local situation and so-called dirty mouths explain the findings. The present series, a study from Washington, includes a cosmopolitan population from many parts of the world all of whom practice a mouth hygiene above the average. In this group,

4. Willett, R. C.: J. A. D. A., 16:389 (March) 1929.

5. Price, W. A.: Calcium Metabolism Studies on the Nature and Rôle of the Activators: Researches on Fundamentals for the Prevention of Dental Disease, J. A. D. A., 16:265 (Feb.) 1929.

I have seen some of the worst cases of progressive gingivitis. The disease, therefore, has a world-wide distribution, better or worse probably in some parts and is not dependent alone on poor mouth hygiene. Next to cleaning up of the infection, scrupulous mouth hygiene is a most important item in checking the progression.

Such irritations as smoking and chewing tobacco play no part whatsoever except that tobacco stains collections of exudate which become adherent to the necks of teeth, the so-called tartar. Chewing gum, if anything, has a favorable action as far as mechanically the sulci tend to be obliterated, and the increased saliva dilutes to a certain extent the bacterial flora. This statement does not in any way suggest gum chewing as a means of preventing gingivitis.

The presence of tartar and calculus about the necks of teeth and in gingival sulci and pockets I still believe is a result of the presence of gingival exudate and not primarily a cause of progressive gingivitis. More careful work must be done on the chemical side of oral calculi. When the final analysis is made, there will be found to be a single mechanism from all types; that is, the exudative serum, red blood cells, pus cells, débris, bacteria and salivary calcium tend to calcify, as elsewhere in the body when residual. The excellent early work of Black[6] on serumal and salivary calculus was a careful analysis, but in the light of our more modern opportunities, the explanation will change. In my first paper,[2] I made the statement that "the general practice of scaling might as well stop right now." So much exception has been taken to that portion quoted, in spite of the fact that I also said "all traumatic calculi and gross collections of tartar should be removed," that a further explanation seems necessary. No matter how thoroughly these calcareous deposits are removed, the progressive gingivitis continues in spite of even monthly inspection and careful cleaning by a qualified oral hygienist. If the infections are cleared up in a case of gingivitis, if all tartar and calculi are removed, and if thorough intelligent daily mouth hygiene is carefully carried out, tartar will not recur, except in inaccessible places, especially on the lingual side of the lower central incisors and in tight interproximal spaces. These should be cleaned out by scaling from time to time. What I meant before and what I still mean is that the general practice of scaling as the sole effort at eradication of progressive gingivitis is useless. As an adjunct to the general treatment of a given case, it has the importance that I have stated.

The general use of tooth powders, pastes, mouth washes and toothbrushes of all sorts and types, while a most lucrative source of income to a large number of manufacturers, is doing little in the actual eradication of progressive gingivitis. I should like to spend much time on the different angles of this phase, but will have to limit my discussion to that portion of the paper on treatment. There is no single specific cause of progressive gingivitis; therefore, there is no short cut by a single specific type of treatment, mouth hygiene included.

The great question of acid mouth has arisen from the fact that saliva was considered alkaline by the early physiologists, or at least that impression had gained a firm foothold. Then it was found, where occasionally tested, that mouths gave at times an acid reaction to litmus, and the acid mouth became a cloudy entity along with uric acid diathesis in the blood.

6. Black, G. V.: Special Dental Pathology, Ed. 2, Chicago, Medico-Dental Publishing Co.

Both of these obscure conditions have been fostered by extensive commercial advertising. In a recent editorial[7] in the *Journal of the American Medical Association,* this subject is tersely reviewed. Clark and Carter[8] describe the tendency of the saliva to return to its normal state in the following words: "Accepting an average p_H of 6.6 (for normal saliva), which is slightly on the acid side, it is evident that saliva is a well buffered mixture and would be able to neutralize large amounts of hydrogen or hydroxyl ions without showing appreciable change in the p_H value."

I have previously reported[2] a small group in which the hydrogen ion concentration of gingival exudates was shown to be on the average 5.7. This is somewhat lower than saliva is generally, and the presence of the acid-forming bacteria in the gingival sulci was suggested as the explanation.

It goes without saying that ill-fitting crowns, pivots, inlays, bridges and dentures and neglected caries may be contributory causes to the progression of gingivitis. The mere correction of these conditions, while improving a given mouth, will not eliminate the gingivitis. I have had under observation a man whose mouth presents a very difficult condition. He wears a partial upper denture and he has had three different plates made, none of which were at all satisfactory. He had an advanced ulcerative gingivitis with deep pockets and loose teeth to which the plate was attached. It has taken months of constant treatment, and he now has a recession that exposes even under the bifurcation of molar roots, but his fourth plate fits perfectly, with absolute comfort. It would have been a much simpler proposition to have extracted all the teeth, but he insisted on keeping what was left, and with intelligent cooperation on his part his mouth was made very comfortable, with teeth tight in their sockets; and with the care he takes, this condition should remain almost indefinitely.

In an examination of a given mouth from the laboratory standpoint, I think the greatest assistance to the dentist may be had from the following: 1. A record of the problem and a brief history of the mouth. 2. A description of the mouth from the infectious standpoint, assuming the dental aspects. (Roentgenograms are a great help at this point.) 3. Smears, fresh, stained or darkfield, outlining the character of the exudate. (This is, in order, borrelia, fusiform bacilli, protozoa, recognizable bacterial types, pus, cells, débris, yeasts and higher mycelia forms grouped under leptothrix. 4. Cultural characters as found in different areas on blood-agar plates. This will include all the cocci, many of the bacilli and the symbiotic relationship of certain fusiform types. I would include anaerobic cultures routinely. Better cultural methods must be devised to bring out the spirilla types, comma-like bacilli, mycelial threads and actinomycotic-like granules before these phases are cleared up. 5. A chemotherapeutic outline, as already described[9] of different antiseptic possibilities. Cultures are made at the time of examination directly from sulci and read after twenty-four hours incubation. From this, therapeutic agents having a direct bacteriolytic

7. A Biochemical View of "Acid Mouth," editorial, J. A. M. A., 92:899 (March 16) 1929.

8. Clark, G. W., and Carter, K. L.: Factors Involved in the Reaction Changes of Human Saliva, J. Biol. Chem., 73:391 (June) 1927.

9. Keilty, R. A.: Specificity of Bacteria to the Bacteriolytic Action of Chemicals with a Note on Their Application to Chemotherapy, J. Lab. & Clin. Med., 14:539 (March) 1929.

action on the mouth under study are determined. Finally, suggestions for treatment are made from the standpoint of infection, including drugs, dilutions, amounts, frequency and future possibilities. Here, some tact and common sense are necessary. The complete accord and sympathy of the dentist must be known, and I believe it is the sphere (it certainly works out for me) of the clinical pathologist not only to enumerate the flat results of smears and cultures but also to give some explanations and suggestions from his pathologic experience of the conditions involved. The clinician need not follow this out to the letter, but he can certainly be directed and guided and is better able to obtain good results.

In checking over the histories of the last 100 private cases which I have seen since the first of this year, using the methods which I have outlined, there are some interesting results. I find that cases were referred by nineteen different medical and dental men, with fifty-six cases from three dentists. As previously outlined, classified under normal, there were three, and under gingivitis—acute, subacute and chronic—ninety-seven. (Table 1.) This percentage is high and is not to be taken as the general incidence of gingivitis because these cases had been picked out by the doctor or dentist first. We found the incidence in 5,000 cases reported to be 90 per cent showing evidence of gingivitis, and this is rather high, since it represented hospital admissions. Fifteen cases were acute; eleven, subacute, and seventy-one, chronic. Twelve cases showed roentgen-ray evidence of periodontitis. Classed as a group, seventeen were mild; fifty-nine, moderate, and twenty-one, advanced. One case was associated with general acute stomatitis. One case was a pure endamebic gingivitis without any other factor. This is very rare, but is a possible entity.

Grouped as a whole, in the ninety-seven cases in which gingivitis was present, the infectious factors were as follows: borrelia and fusiformis, present, 94; not present, 3; endameba, present, 74; not present, 23; *Trichomonas buccalis,* present, 1. (Table 2.)

In the order of their predominance, the following bacteria (Table 3) were

Table 1.—Résumé of 100 Cases of Gingivitis

Total number of cases	100
Normal	3
Gingivitis	97
Acute	15
Subacute	11
Chronic	71
Mild	17
Moderate	59
Advanced	21
With periodontitis (roentgen ray)	12

Table 2.—Infectious Factors in 97 Cases of Gingivitis

	Present Cases	Not Present Cases
Borrelia vincenti	94	3
Fusiformis	94	3
Endameba gingivalis	74	23
Trichomonas buccalis	1	96

Table 3.—Bacterial Infectious Factors in 97 Cases of Gingivitis

Streptococcus hemolyticus	67
Staphylococcus (not typed)	49
Pneumococcus	42
Staphylococcus, muddy	32
Streptococcus, green hemolytic	26
Fusiform bacilli and cocci	20
Streptococcus, nonhemolytic	17
Staphylococcus, white	14
Micrococcus catarrhalis	11
Streptococcus, digesting	5
Bacillus hoffmannii	4
Staphylococcus hemolyticus	3
Staphylococcus aureus	2
Bacillus diphtheriae (virulent)	2
Yeast	1
Bacillus, unidentified	1

obtained on culture: hemolytic streptococci, 67; staphylococci, 49; pneumococci, 42; muddy staphylococci, 32; green hemolytic streptococci, 26; cases of bacillary symbiosis (fusiform bacilli with cocci), 20; streptococci (nonhemolytic), 17; white staphylococci, 14; *Micrococcus catarrhalis,* 11; small digesting streptococci, 5; *B. hoffmannii,* 4; hemolytic staphylococci, 3; *Staphylococcus aureus,* 2; *B. diphtheriae* (virulent), 2; yeast, 1; unidentified bacillus, 1. The total number of different organisms in each case were as follows: one organism occurred in two cases; two in thirty; three in thirty-one; four in eighteen; five in ten, and six in two.

Of the ninety-seven cases, thirty have been seen a second time for a checkup from the physical and bacteriologic point of view, ten days after all dental work was completed. Twenty-three were completely cleaned up; six were improved, with residual areas, and were sent back for further treatment. One was no better and, on checking, it was found that the character of treatment as outlined was not carried out but other methods used. This case is now under appropriate treatment. It is our desire to check all cases ten days after the first complete cleaning up by the dentist, and to suggest a monthly check by the dentist for six months until the case is under complete control. The case is not returned to the laboratory unless new developments arise. We are now checking over about 500 cases at the end of a year in which an attempt has been made to carry out this method. The results of this check from year to year will, we hope, be not only interesting but also instructive.

A study of the reasons for sending these cases to the laboratory reveals some interesting examples, which multiply as the series increases. Thirty-one cases were sent as a routine part of a dental examination; four, as advanced pyorrhea, by physicians; fourteen, because of mouth bleeding; thirteen, gingival bleeding and sensitive dentin; one, recession (sent by a physician); one, trench mouth (sent by a physician); one, local ulceration (endamebic); one, postoperative dental infection; one, for a preoperative dental cleaning up; one, undue ulceration, and one, excessive tartar formation. Thirty-one cases were referred in a search for a focus of infection in which gingivitis might play a part, and these were distributed as follows: eye, four cases; arthritis, infectious type, six; facial neuritis, two; fatigue, two; lumbar pains, three, and one case of each of the following: gallbladder disease, myocarditis, sinus and antrum conditions, leukoplakia, pain in mandible, phlebitis, harelip, herpes zoster, toxic thyroid, nervous and mental condition, gastro-intestinal disturbance, myositis, multiple abscess and leg pains.

From the standpoint of a portal of entry for micro-organisms, the unprotected inflammatory gingival sulcus offers one of the most prolific sources in the body. Here, almost the entire gamut of bacteria reside and may possibly enter the blood stream at any time. Indeed, after a fairly large series of blood cultures in connection with focal infection studies, I am convinced we are many more times the victims of transitory bacteriemia without the classic, recognized symptoms than we have any idea of.

The seasonal changes in bacterial flora, in general, which have been noted by many observers, are most striking in a checking up of gingival cultures, month by month, over a period of years. For example, the presence of at least two, three, four, five or even six different types of charted colonies, which is a mini-

mum and not a maximum, in the cultures made during and just after the recent pandemic of so-called influenza, contrasts notably with the majority of cases, in which one, two or three and rarely ever four are found, in the warm summer months. During these summer months, the pneumococcus disappears almost entirely in the cultures, while it appeared in 42 per cent of the recent series. May we not conclude, until more definite proof is advanced, that the infected gingival sulcus, and *pari passu* the subgingival corium, is a dangerous portal of entry for micro-organisms.

Streptococcus viridans is considered by Rosenow as one of the most frequent invaders in periapical bony involvements, and our own work bears this out. After a careful technical study of root canals in teeth, removed either by extraction or surgical exposure, with the finding of this streptococcus on the root tip or in the so-called periapical cyst, we are often unable to find it in the root canals. I feel that the gingival sulci and the periodontal membrane is the tract of infection, and not the root canal, in many cases. From these findings, for some time past I have felt sure that every pulpless tooth with a root canal filling is not necessarily a menace unless it has an extensive gingival involvement with a periodontitis. There is still too great a sacrifice of perfectly healthy teeth in the name of focal infection. This does not detract in the least from the basic principle, which is now definitely proved, it seems to me, that the infected tooth is a menace.

Further understanding of bacteriology and chemotherapeutics, and better judgment in weighing whatever the detail man has to say, will make safer, more nearly sterile root-canal fillings in the future. You have all seen many root canals, filled for years, that, in the absence of gingivitis, show absolutely no roentgen-ray evidence of bone involvement. Thus, gingivitis affords one of the most important portals of entry for micro-organisms in the chain of foci of infection and should not be neglected in the study. In a gingival cleaning up, as elsewhere in foci eradication, some startling results are at times obtained; but this cannot be looked for in every case. Sometimes, as with tonsils and gallbladder removal, no improvement results.

When the gingivae are treated, before any extractions or when extensive dental surgery is planned, until they are relatively exudate free, be the time whatever is necessary, a few days, a week or two months, I have never seen a postoperative local infectious reaction. This fact was first brought out by Vastine four years ago and allowed him to proceed with more radical cleaning up. This record is being maintained in Washington, and I feel no hesitancy in saying to an oral surgeon, "This mouth is clean and your operative work may be as extensive as you wish." This ends the problem of one tooth today, one next week and one thereafter weekly until all are cared for. During this time, I have seen many postoperative infections, acute ulcerative gingivitis, stomatitis, cellulitis and a few deaths when preoperative treatment was not carried out. This is to be expected when the infectious side of gingivitis is not carefully considered or totally disregarded.

When the case has been carefully studied, a more intelligent plan of treatment can be carried out by the dentist, and the end-results are most satisfactory from the standpoint of the patient, the dentist and the physician. The infectious elements have so much influence on so many sides of the question that I think it

Both of these obscure conditions have been fostered by extensive commercial advertising. In a recent editorial[7] in the *Journal of the American Medical Association,* this subject is tersely reviewed. Clark and Carter[8] describe the tendency of the saliva to return to its normal state in the following words: "Accepting an average p_H of 6.6 (for normal saliva), which is slightly on the acid side, it is evident that saliva is a well buffered mixture and would be able to neutralize large amounts of hydrogen or hydroxyl ions without showing appreciable change in the p_H value."

I have previously reported[2] a small group in which the hydrogen ion concentration of gingival exudates was shown to be on the average 5.7. This is somewhat lower than saliva is generally, and the presence of the acid-forming bacteria in the gingival sulci was suggested as the explanation.

It goes without saying that ill-fitting crowns, pivots, inlays, bridges and dentures and neglected caries may be contributory causes to the progression of gingivitis. The mere correction of these conditions, while improving a given mouth, will not eliminate the gingivitis. I have had under observation a man whose mouth presents a very difficult condition. He wears a partial upper denture and he has had three different plates made, none of which were at all satisfactory. He had an advanced ulcerative gingivitis with deep pockets and loose teeth to which the plate was attached. It has taken months of constant treatment, and he now has a recession that exposes even under the bifurcation of molar roots, but his fourth plate fits perfectly, with absolute comfort. It would have been a much simpler proposition to have extracted all the teeth, but he insisted on keeping what was left, and with intelligent cooperation on his part his mouth was made very comfortable, with teeth tight in their sockets; and with the care he takes, this condition should remain almost indefinitely.

In an examination of a given mouth from the laboratory standpoint, I think the greatest assistance to the dentist may be had from the following: 1. A record of the problem and a brief history of the mouth. 2. A description of the mouth from the infectious standpoint, assuming the dental aspects. (Roentgenograms are a great help at this point.) 3. Smears, fresh, stained or darkfield, outlining the character of the exudate. (This is, in order, borrelia, fusiform bacilli, protozoa, recognizable bacterial types, pus, cells, débris, yeasts and higher mycelia forms grouped under leptothrix. 4. Cultural characters as found in different areas on blood-agar plates. This will include all the cocci, many of the bacilli and the symbiotic relationship of certain fusiform types. I would include anaerobic cultures routinely. Better cultural methods must be devised to bring out the spirilla types, comma-like bacilli, mycelial threads and actinomycotic-like granules before these phases are cleared up. 5. A chemotherapeutic outline, as already described[9] of different antiseptic possibilities. Cultures are made at the time of examination directly from sulci and read after twenty-four hours incubation. From this, therapeutic agents having a direct bacteriolytic

7. A Biochemical View of "Acid Mouth," editorial, J. A. M. A., 92:899 (March 16) 1929.

8. Clark, G. W., and Carter, K. L.: Factors Involved in the Reaction Changes of Human Saliva, J. Biol. Chem., 73:391 (June) 1927.

9. Keilty, R. A.: Specificity of Bacteria to the Bacteriolytic Action of Chemicals with a Note on Their Application to Chemotherapy, J. Lab. & Clin. Med., 14:539 (March) 1929.

action on the mouth under study are determined. Finally, suggestions for treatment are made from the standpoint of infection, including drugs, dilutions, amounts, frequency and future possibilities. Here, some tact and common sense are necessary. The complete accord and sympathy of the dentist must be known, and I believe it is the sphere (it certainly works out for me) of the clinical pathologist not only to enumerate the flat results of smears and cultures but also to give some explanations and suggestions from his pathologic experience of the conditions involved. The clinician need not follow this out to the letter, but he can certainly be directed and guided and is better able to obtain good results.

In checking over the histories of the last 100 private cases which I have seen since the first of this year, using the methods which I have outlined, there are some interesting results. I find that cases were referred by nineteen different medical and dental men, with fifty-six cases from three dentists. As previously outlined, classified under normal, there were three, and under gingivitis—acute, subacute and chronic—ninety-seven. (Table 1.) This percentage is high and is not to be taken as the general incidence of gingivitis because these cases had been picked out by the doctor or dentist first. We found the incidence in 5,000 cases reported to be 90 per cent showing evidence of gingivitis, and this is rather high, since it represented hospital admissions. Fifteen cases were acute; eleven, subacute, and seventy-one, chronic. Twelve cases showed roentgen-ray evidence of periodontitis. Classed as a group, seventeen were mild; fifty-nine, moderate, and twenty-one, advanced. One case was associated with general acute stomatitis. One case was a pure endamebic gingivitis without any other factor. This is very rare, but is a possible entity.

Grouped as a whole, in the ninety-seven cases in which gingivitis was present, the infectious factors were as follows: borrelia and fusiformis, present, 94; not present, 3; endameba, present, 74; not present, 23; *Trichomonas buccalis,* present, 1. (Table 2.)

In the order of their predominance, the following bacteria (Table 3) were

TABLE 1.—RÉSUMÉ OF 100 CASES OF GINGIVITIS

Total number of cases	100
Normal	3
Gingivitis	97
Acute	15
Subacute	11
Chronic	71
Mild	17
Moderate	59
Advanced	21
With periodontitis (roentgen ray)	12

TABLE 2.—INFECTIOUS FACTORS IN 97 CASES OF GINGIVITIS

	Present Cases	Not Present Cases
Borrelia vincenti	94	3
Fusiformis	94	3
Endameba gingivalis	74	23
Trichomonas buccalis	1	96

TABLE 3.—BACTERIAL INFECTIOUS FACTORS IN 97 CASES OF GINGIVITIS

Streptococcus hemolyticus	67
Staphylococcus (not typed)	49
Pneumococcus	42
Staphylococcus, muddy	32
Streptococcus, green hemolytic	26
Fusiform bacilli and cocci	20
Streptococcus, nonhemolytic	17
Staphylococcus, white	14
Micrococcus catarrhalis	11
Streptococcus, digesting	5
Bacillus hoffmannii	4
Staphylococcus hemolyticus	3
Staphylococcus aureus	2
Bacillus diphtheriae (virulent)	2
Yeast	1
Bacillus, unidentified	1

obtained on culture: hemolytic streptococci, 67; staphylococci, 49; pneumococci, 42; muddy staphylococci, 32; green hemolytic streptococci, 26; cases of bacillary symbiosis (fusiform bacilli with cocci), 20; streptococci (nonhemolytic), 17; white staphylococci, 14; *Micrococcus catarrhalis,* 11; small digesting streptococci, 5; *B. hoffmannii,* 4; hemolytic staphylococci, 3; *Staphylococcus aureus,* 2; *B. diphtheriae* (virulent), 2; yeast, 1; unidentified bacillus, 1. The total number of different organisms in each case were as follows: one organism occurred in two cases; two in thirty; three in thirty-one; four in eighteen; five in ten, and six in two.

Of the ninety-seven cases, thirty have been seen a second time for a checkup from the physical and bacteriologic point of view, ten days after all dental work was completed. Twenty-three were completely cleaned up; six were improved, with residual areas, and were sent back for further treatment. One was no better and, on checking, it was found that the character of treatment as outlined was not carried out but other methods used. This case is now under appropriate treatment. It is our desire to check all cases ten days after the first complete cleaning up by the dentist, and to suggest a monthly check by the dentist for six months until the case is under complete control. The case is not returned to the laboratory unless new developments arise. We are now checking over about 500 cases at the end of a year in which an attempt has been made to carry out this method. The results of this check from year to year will, we hope, be not only interesting but also instructive.

A study of the reasons for sending these cases to the laboratory reveals some interesting examples, which multiply as the series increases. Thirty-one cases were sent as a routine part of a dental examination; four, as advanced pyorrhea, by physicians; fourteen, because of mouth bleeding; thirteen, gingival bleeding and sensitive dentin; one, recession (sent by a physician); one, trench mouth (sent by a physician); one, local ulceration (endamebic); one, postoperative dental infection; one, for a preoperative dental cleaning up; one, undue ulceration, and one, excessive tartar formation. Thirty-one cases were referred in a search for a focus of infection in which gingivitis might play a part, and these were distributed as follows: eye, four cases; arthritis, infectious type, six; facial neuritis, two; fatigue, two; lumbar pains, three, and one case of each of the following: gallbladder disease, myocarditis, sinus and antrum conditions, leukoplakia, pain in mandible, phlebitis, harelip, herpes zoster, toxic thyroid, nervous and mental condition, gastro-intestinal disturbance, myositis, multiple abscess and leg pains.

From the standpoint of a portal of entry for micro-organisms, the unprotected inflammatory gingival sulcus offers one of the most prolific sources in the body. Here, almost the entire gamut of bacteria reside and may possibly enter the blood stream at any time. Indeed, after a fairly large series of blood cultures in connection with focal infection studies, I am convinced we are many more times the victims of transitory bacteriemia without the classic, recognized symptoms than we have any idea of.

The seasonal changes in bacterial flora, in general, which have been noted by many observers, are most striking in a checking up of gingival cultures, month by month, over a period of years. For example, the presence of at least two, three, four, five or even six different types of charted colonies, which is a mini-

mum and not a maximum, in the cultures made during and just after the recent pandemic of so-called influenza, contrasts notably with the majority of cases, in which one, two or three and rarely ever four are found, in the warm summer months. During these summer months, the pneumococcus disappears almost entirely in the cultures, while it appeared in 42 per cent of the recent series. May we not conclude, until more definite proof is advanced, that the infected gingival sulcus, and *pari passu* the subgingival corium, is a dangerous portal of entry for micro-organisms.

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When the case has been carefully studied, a more intelligent plan of treatment can be carried out by the dentist, and the end-results are most satisfactory from the standpoint of the patient, the dentist and the physician. The infectious elements have so much influence on so many sides of the question that I think it

is fair to give them prime importance. I cannot understand why this point has been so completely neglected in the past, but I do think that the present trend of opinion is toward its importance.

In this paper, I am unable to go into the details of any treatment, but I will try to outline the principles by which results are obtained. In the first place, it is necessary to have laboratory cooperation, and the pathologist must have a working knowledge of conditions. The greater his experience, the more valuable his opinions. Secondly, the dentist must be in accord and sympathy and must give the whole subject his attention until he can see for himself results which he has never seen before by any means now at his disposal. Thirdly, the patient must be instructed, and, in the majority of cases, he will give complete cooperation.

The gingivitis must be treated locally. This can be done by medical and surgical means. The dental conditions must be entirely corrected either during or immediately after the cleaning up of the gingival condition. Before medical treatment for gingivitis is instituted, the types of organisms present, with relative numbers and the extent of the condition, must be worked out. The use of a specific chemotherapy as checked against each mouth entails some extra work, but is well worth the time and trouble. Given these data, the next problem is an understanding of general chemotherapeutic measures, of which many of the principles have been worked out by Kolmer. From an article published in the *Journal of Chemotherapy*,[10] I have the following paragraph to cover this point:

> There are certain conditions which must be taken into account in successful chemotherapeusis against infections in general. Substances must have an inherent bactericidal value. They must not produce necrosis in the tissue to which they are applied and they must not produce *per se* a process of exudation. Bactericidal substances must come directly in contact with the bacteria in such dilution or concentration that their full bactericidal power may be available. It is not necessary, no matter how desirable, that death of bacteria be brought about within a few seconds. Such reaction, if obtainable by a weaker solution over a longer period of time, may be gained by improvement in application or by a frequent repetition. To obtain the quickest and most efficient results a concentrated mass attack must be made upon the infection in order to produce as much bacteriolysis as possible before adaptation of the bacteria to the reagent takes place. When the infection is reduced to the minimum the tissues in their own battle will mop up the remnants.

The following drugs are used: hydrogen peroxid (this acts as an acid and should always be alkalinized after its use); physiologic sodium chlorid solution (pure salt has no advantage and some disadvantage); sodium bicarbonate in weak solution; surgical solution of chlorinated soda (Dakin's) (either made up at 0.2 per cent or from chloramine, U. S. P., tablets and not to be indefinitely continued because of stain and irritation); mercurochrome 220 soluble (from 1 to 2 per cent in selected cases only); acriflavin (1 per cent watery solution); acriviolet (1 per cent watery solution); metaphen (watery solution, 1:500); mercurophen (watery solution, from 1:100 to 1:500); hexylresorcinol (solution as furnished, 1:800, in selected cases only); arsphenamin (from 0.6 or 0.9 gm. in from 10 to 15 c.c. of glycerin, used locally, there being no action when given intravenously, and this method for mouth borrelia is useless); and emetin hydrochlorid (given three to six doses once a day hypodermically in one-half grains, a specific for endamebae only, and caution

10. Keilty, R. A.: Specific Chemotherapeusis with Relationship to the Bacteria Involved, J. Chemotherapy, 6:9 (April) 1929.

must be taken against possible severe local reactions). We have used and discarded a number of other substances and have on trial still other substances. The list of drugs enumerated gives one an opportunity to meet the several conditions which exist.

The next point is the time of application. This will depend entirely on the individual case. The time of treatments will range from every two hours in the acutely ill hospitalized patients to once a day. The treatments should be repeated frequently enough to get control. The average chronic case will run daily for from ten days to two weeks, with biweekly or weekly checking for the persistent areas.

The method of application is one of the most troublesome and is, of course, most important. The drug must come in contact with the bacteria in the depths of the pockets. Applicators, syringes and instruments may be necessary. The rubber cup applicator consisting of a porte polisher with a ferrule holding a rubber cup polisher, worked out by Vastine, is by far the most satisfactory. This is not a question of polishing nor massage but is an attempt to force the drug into the depths of pockets by intermittent pressure and vacuum. With this method, several substances can be used, one following the other.

The cooperation of the patient must be obtained in an improvement in mouth nygiene. Specific treatments to be undertaken by the patient are only recommended from our experience in very exceptional cases. Mouth hygiene consists of cleaning out the mouth in the same way that the rest of the body is kept clean, with plenty of soap and water. Castile soap and a good toothbrush will do all that can be expected. This may be augmented by a mild abrasive powder and by a final rinsing of the mouth with a mild alkaline solution. Most patients have some type of paste or powder which they prefer, and if proper methods of brushing can be instituted, this may suffice. It is most important that the mouth be kept scrupulously clean after it has been thoroughly treated. The question of reinfection by kissing should always be explained.

I have always been opposed to extensive surgery as advocated by Neuman in the treatment of gingivitis. More recent developments, especially that being carried out in selected cases, will shorten the time and, in conjunction with treatment, will undoubtedly make the final result more nearly permanent.

CONCLUSION

An open mind and conservative judgment will count in the final victory over inflammatory changes in the gingiva. Gingivitis in some form is one of the most widespread conditions which we have to deal with. It is a dental problem from the standpoint of its etiology and correction and it is a medical problem from the standpoint of loss of masticators, portals of entry and focus of infection. It is a research problem to work out several points in the bacteriology which are now obscure.

SHOULD ORAL SURGERY HAVE A PLACE IN THE UNDERGRADUATE CURRICULUM IN DENTISTRY?*

By FULTON E. RISDON, M.B., F.A.C.S., D.D.S., Toronto, Canada

IN reply to the question "Should oral surgery have a place in the undergraduate curriculum in dentistry," I would answer in the affirmative. The objective should be the teaching of surgical technic. We believe that it is impossible to teach technic didactically, but that does not mean that lectures are valueless. In fact, most of our work at present is taught from that standpoint, but I am sure that for years all of us have recognized that method as being ineffective. I believe that the surgical conscience can best be trained in the general hospital operating room and not in the special hospital operating room. Furthermore, the better the technic, the easier it will be to render it automatic. We are teaching bone surgery, the type of surgery that requires a most exacting technic, because, as we inform our students, we are really working in the blood stream when we are in bone, and any contamination introduced may have a fatal result. Further, we try to show that, frequently, general septicemia can occur after simple extraction where the technic has been poor.

The character of the teaching should be such that the care of the patient is paramount and the training of the student is only incidental, and this can best be done, first, by lectures, and, secondly, by personal demonstrations in the operating room. The student must "get his hand in" as much as possible, since, we all will admit, the power of observation is poorly developed, especially in the student.

In the graduate teaching of oral surgery, it is rather difficult to outline the requirements for admission to such a course, but as a large percentage of men taking such a course will confine their work to exodontia and minor oral surgery, I see no reason why the question of requirements should be considered at this time. I do not believe that a sufficient number of men with both dental and medical degrees will present themselves to take care of the public, and, further, if a man having both degrees does require such training, he can best obtain it, first, by having his dental training; later, his surgical and general hospital training, and, finally, his training in special surgery: ear, nose and throat.

The instruction should be given by the man best trained for this type of teaching, and I believe that, in the future, he will probably take a combined medical and dental course and at least one year in a general hospital, completing his training with one year and a half in a special ear, nose and throat hospital. As I have stated before, I doubt that the student will be willing to take such an extended

*The papers of Drs. Risdon, Mead, Lyons and Dunning were presented as a symposium.

*Read before the group conference on Oral Surgery at the Sixth Annual Meeting of the American Association of Dental Schools, Chicago, Ill., March 26, 1929.

course, as that requires at least eleven and a half or twelve years, and he then emerges as an ultra-specialist, working in rather a limited field. Would it not be possible to select well-trained dental graduates and encourage them to take one or two years in general hospital training, with some special training such as pathology or otolaryngology, and then encourage them to confine their work to exodontia and minor oral surgery? Again, recent graduates in medicine might take one or more years in dentistry, and complete their course with some special training.

As to the desire for uniformity in the teaching of oral surgery for the undergraduate and graduate, may I say, subject to correction, that I do not know of any institution where oral surgery, as such, is being taught, and I believe that there is a good reason for this situation. If one thinks of the extraction of teeth and other minor procedures as oral surgery, we know of a number of colleges where such a course is given. I would venture to say that 99 per cent of our students will come to us with dental training only, and I believe that we should concentrate on teaching minor oral procedures and we should teach from the standpoint of surgical technic, both by lectures and by demonstrations. The small percentage of men having both medical and dental degrees who will present themselves could best be trained by the general surgeon and the special surgeon, and their training be supplemented by the oral surgeon. The faculty should entrust the teaching of major and minor oral surgery to one chief, and exodontia, while not taught by him necessarily, should come under his department. This I believe to be the logical conclusion, if the extraction of teeth is considered surgery.

SHOULD ORAL SURGERY HAVE A PLACE IN THE UNDERGRADUATE CURRICULUM IN DENTISTRY?*

By STERLING V. MEAD, D.D.S., Washington, D. C.

ORAL surgery may be defined as "surgery of the mouth, mandible, maxillae, and adjacent structures." It should be divided into two separate fields: minor oral surgery and major oral surgery. It is manifestly impossible to draw an absolute line of separation between these two fields, as many cases may involve both fields. For instance, a simple fracture may be a problem of minor oral surgery; whereas, a fracture involving a bone graft will become a major surgical operation. The removal of a tooth may be a minor operation, but major surgical procedures may become necessary owing to infection, etc.

Minor oral surgery should have a definite and important place in the undergraduate curriculum in the dental school.

UNDERGRADUATE (MINOR) ORAL SURGERY

What should be the objective? What should be included in the course? What

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should be the character and method of teaching?

With a proper knowledge of the principles and procedures in minor oral surgery, one can better understand pathology and diagnosis and more fully appreciate the requirements of successful operations.

The course should include exodontia, minor oral surgery, local anesthesia and general anesthesia.

Teaching should be both theoretical and practical, with ample clinical material available. The use of lantern slide lectures, moving pictures and actual demonstrations should be encouraged. Students should be required to have actual clinical experience before graduation. The student should be taught hospital routine, sterilization and procedure. He should receive practical demonstration along this line.

In our present curriculum, the time is so limited that it is difficult to teach the undergraduates all the essentials of minor oral surgery. They are not qualified to undertake the study of major oral surgery and do not derive marked benefit from it, and any time spent on it could more profitably be spent on minor oral surgery.

At Georgetown University, we have adopted the plan of teaching oral diagnosis and diseases of the mouth to the junior students, taking away from oral surgery such subjects as diagnosis, infections and stomatitis.

When the undergraduate enters the senior year, having had training in the subjects of anatomy, histology, pathology, physiology, diagnosis, etc., he is in a receptive condition to consider surgical procedure. He is taught minor oral surgery from both a theoretical and a practical standpoint. During the year, he is permitted to witness a few well chosen major oral surgical operations for general hospital and professional training. I do not believe that he should be required to be examined in major oral surgical procedures.

GRADUATE TEACHING

In the graduate teaching of oral surgery what should be the requirements for admission to such course of instruction? Should instruction be given under the dental or the medical faculty? Any one possessing the M.D. or the D.D.S. degree from a recognized college should be admitted to the course on major oral surgery. Some suitable degree should be given at the successful completion of the course.

While it is reasonable to believe that to possess both an M.D. and a D.D.S. degree shows higher education and training, and is to be desired, it is not thought necessary, and with our present extensive courses in both schools, to obtain both degrees is an economic hardship.

The course should be of long enough duration and of such a character as to train men so well in oral surgical procedures that they will be accepted by both the medical and the dental profession, and recognized as having the proper training. Hospital training should be a definite requirement.

MAJOR ORAL SURGERY

We believe that major oral surgery should be taught in the dental school by the dental faculty. There should be the proper cooperation with the different departments of the medical school. The maxillary sinus, for instance, should be considered from the standpoint of the rhinologist and the oral surgeon. Different conditions will have a bearing upon the teaching personnel.

DEGREE

As to whether oral surgery is a part of medicine or dentistry, and the degree

necessary to practice this specialty, I agree with Harrison, who states, "I am not acquainted with the medical schools which adequately teach the pathology and surgery of the mouth."

Oral surgery is taught in all dental colleges and all state boards examine candidates on the subject. A license to practice dentistry, therefore, carries with it the legal right to practice oral surgery. It is not the medical or dental degree that qualifies one for the practice of oral surgery, but a broad and general fundamental knowledge of the principles of diagnosis, surgical pathology and experience and judgment, and oral surgical procedures.

Every dentist should become qualified to recognize pathologic processes in the mouth, but he should attempt treatment of only those cases which he is fully qualified to manage successfully.

Any one practicing major oral surgery should have the ability and experience necessary to handle conditions in the mouth successfully even though complicated by extension to other parts. He should know when and whom to call for consultation and advice.

It will be just as unreasonable to believe that the general dental practitioner can be prevented from practicing oral surgery as it is to think that a physician can be prevented from practicing surgery or doing the work of any specialist. In the rural districts, this would be a more difficult matter to control. It would be desirable if a plan could be evolved whereby any one who uses the term "oral surgeon" or professes to specialize in this field would be required to pass a special examination for this purpose. When he uses the term "oral surgeon" or "oral surgery" or professes to specialize in this field, he assumes the responsibilities and liabilities of those qualified in this work.

UNIFORM COURSE

Is it desirable to endeavor to make the undergraduate and graduate teaching of oral surgery more nearly uniform in the schools of the country? It would be of great importance and assistance to the dental schools if the American Association of Dental Schools could recommend a course of study for minor oral surgery and major oral surgery. The following are tentative outlines of these courses, which we submit for your consideration.

At the present time, there is a wide difference of opinion as to the proper course of oral surgery in the dental school. In some schools, for instance, general anesthesia is not properly taught, the opinion being that it should not be used by the dental surgeon. It must be remembered that general anesthesia has been brought to the present usefulness through general improvement by the dentist.

It would be of great benefit if a standardized course in oral surgery could be outlined so that each school would know what would be required of an undergraduate, as a plan of this kind cannot be followed if the state boards are not in accord with it.

MINOR ORAL SURGERY

Examination of the mouth.
Recording results of examination.
Anatomy of the mouth.
Choice of anesthesia.
General anesthesia.
Local anesthesia.
Preoperative preparation.
Surgical technic and hospitalization.
Bandages, sutures and dressings.
Inflammation and infection.
Special infections.
Exodontia.
Wounds.

Periapical diseases.
Periodontal diseases.
Apicoectomy.
Alveolectomy.
Replantation.
Fracture of maxilla.
Fracture of mandible.
Injuries of teeth and alveolar process.
Diseases of maxillary bones.
Temporomandibular joint.
Diseases of salivary glands, stones, etc.
Diseases of maxillary sinus.
Diseases of lymph glands.
Hemorrhage.
Surgical and psychic shock; its causes, prevention and treatment.
Accidents.
Foreign bodies.
Cutting frenum and muscular attachments.
Operative accidents.
Residual infection.
Tumors, cysts.
Physiotherapy.

MAJOR ORAL SURGERY

Physical examination—anatomic consideration.
Diagnosis of diseases of the mouth.
Inflammations and infections.
Preparation of the hands, operative field, instruments and dressings.
Hemorrhage, shock and allied complications.
Wounds and injuries of the soft parts.
Injuries of the teeth and alveolar process.
Fractures.
Cleft palate.
Cleft lip.
Obturators, artifical velums and speech training.
Repair of acquired defects in the lips, cheeks and palate.
Treatment of deformaties and malrelations of the jaws.
Diseases of the temporomandibular joint—limited movement of the jaw.
Exodontia.
Infections of the teeth, peridental tissues and maxillary bones.
Septic infections of the floor of the mouth and neck.
Diseases of the maxillary sinus.
Injuries and diseases of the lip.
Affections of the salivary glands and their ducts.
Injuries and diseases of the tongue.
Diseases of the nerves.
Tumors.
Cysts.
Local anesthesia.
General anesthesia.
Physiotherapy.

SHOULD ORAL SURGERY HAVE A PLACE IN THE UNDERGRADUATE CURRICULUM IN DENTISTRY*?

By CHALMERS J. LYONS, D.D.S., Ann Arbor, Mich.

SHOULD oral surgery have a place in the undergraduate curriculum in dentistry? Our answer to this question will be emphatically "yes." If this subject has no place in the dental curriculum, oral surgery as such will not be taught. More than sixty years ago, the great Garrison originated the term "oral surgery," with the idea in mind of linking it up in some way with medicine. Three score years have now passed, and today finds medicine only slightly interested in this subject. In fact, oral surgery is now recognized in but few medical schools of this country, and in these schools it is taught in a very limited and

*Read before the group conference on Oral Surgery at the Sixth Annual Meeting of the American Association of Dental Schools, Chicago, Ill., March 26, 1929.

indifferent manner. I think we are safe in stating that oral surgery has been developed entirely through dental education and is largely confined to and associated with the profession of dentistry.

If taught, what should its objective be? The objective of the course in undergraduate work should be to help to prepare the student for the general practice of dentistry and not in any way to try to fit him to practice the specialty of oral surgery. We believe that one of the objects of instruction in oral surgery has been attained when sufficient knowledge has been imparted to the student to enable him to recognize and diagnose the pathologic lesions of the oral cavity and to instruct the patient intelligently as to the treatment. Many of our graduates locate in smaller centers, where it becomes necessary to treat patients suffering from dental disorders of various kinds. They should be equipped with knowledge that will enable them to treat these conditions intelligently by surgical measures when they are indicated.

What should be included in the course? First, the undergraduate should have a sound foundation in the subject of extraction of teeth and other minor surgical procedures that fall within the realm of the general practice of dentistry. In order to determine the indications and contraindications for the extraction of teeth, he should have some knowledge of physical diagnosis in order to be able to determine, as W. H. G. Logan expresses it, "what teeth shall be extracted." In order to understand minor surgical procedures, he should have a course on the principles of surgery and surgical pathology. He should be made acquainted with the details of the methods by which tissue repairs and of the difference in the quality of tissues and the complications which interfere with the process of repair.

At Michigan, we include in the course on oral surgery lectures and clinical work by the professor of the department of dermatology, on syphilis and other lesions of the mucous membrane. The student should have an opportunity of seeing firsthand all of the mouth lesions with which he may come in contact in the practice of dentistry. Our course on physical diagnosis brings the student into direct contact with the sick patient, where he has an opportunity to become familiar with heart and lung sounds as well as diseases which may be related to mouth conditions. This course is carried out in the hospital. We believe that the undergraduate should have some hospital experience so that he may become familiar with hospital practice. He should observe a few cases in major surgery, following these through and observing the process of repair. We believe that it is a waste of the student's time to observe many of these operations. He is not interested in the technic, and the major surgery clinics should not be attempted with any notion that the student may perform some of these operations himself, but with the idea that it will give him a knowledge as to how patients are treated in a hospital and will enable him to distinguish between the character of sick and of well people.

What should be the character and method of teaching? This is best done by both didactic and clinical methods, attempting to show in a clinical way what has been stated in the class room. We do not believe that this course can be taught as it should be by theoretical work alone but must be accompanied by a well-balanced clinic. The student himself should be required to perform in the clinic any operation in minor surgery which he

might be called on to perform in a dental practice.

In the graduate teaching of oral surgery, what should be the requirement for admission to such a course of instruction? This question has been a debatable one for many years. I am firmly convinced that a young graduate in dentistry with a B record or better has sufficient qualifications to take up graduate work in oral surgery. He has had all of the fundamentals of medicine and is qualified to do advanced work in fields relating to oral surgery. A few years ago before this body, I made the statement that we were confronted with three conditions relating to oral surgery: 1. There is a field for highly trained men in oral surgery and oral diagnosis to be associated with what is known as group medicine. 2. The general practitioner of dentistry does not have the training that will qualify him for such an association. 3. The combined medical and dental course, plus the hospital experience necessary to fit him for oral surgery, is entirely too long to induce any great number to take up the work in a field that is so limited in its possibilities. Recognizing these conditions at Michigan, we have a well established three-year graduate course in oral surgery open to graduate students in dentistry who have received an average B grade or better in their dental course. This course leads to the degree of master of science in oral surgery.

Should the instruction be given under the dental or the medical faculty? I would say that this instruction should be given by both faculties, with the dental faculty supervising the instruction, and should be given in the graduate school where advanced courses only count for credit.

Is it desirable to endeavor to make the undergraduate teaching and graduate teaching in oral surgery more uniform in the dental courses over the country? My answer to this question would be in the affirmative if it were possible. Conditions differ in every institution, and conditions that might be carried out in one institution might be wholly impossible in another. Certain specific requirements might be advantageous, such as at least a two-year residence in a hospital. In my opinion, the most important factor in graduate work in oral surgery is the type of product which results from the teaching. If this specialty can surround itself with high type men who are well educated and well grounded in their work and are morally and physically fit, oral surgery will command the respect to which it is entitled.

SHOULD ORAL SURGERY HAVE A PLACE IN THE UNDERGRADUATE CURRICULUM IN DENTISTRY?*

By HENRY S. DUNNING, B.S., M.D., D.D.S., F.A.C.S., New York City

IT is a fine thing that this association is doing today in discussing the teaching of oral surgery in our schools. I believe that the practice of oral surgery is little understood by the laity, and even the medical profession, and that the teaching of this subject is very meager in spots and ununiform and does not compare favorably with the teaching of surgery in the medical schools. We have discussed this subject in our meetings of the American Association of Oral and Plastic Surgeons, and the members of this body feel, I think, that oral surgery is practiced differently by various men in different parts of the country, and that no two schools teach the subject in a similar manner. Oral surgery is one of the youngest branches of general surgery, and it is an infant that has never found itself either in practice or in the teaching thereof. We have had many distinguished oral surgeons, individually, in the past thirty years, but, unfortunately, we have not done much in an organized way, in promoting the teaching of this specialty. I welcome this opportunity to voice some of my opinions regarding this subject.

According to Dr. Gilmer, it was James E. Garretson, M.D., D.D.S., of Philadelphia, who originated the term "oral surgery." He states that, in 1866, the curriculum of the dental department of the University of Penn was made to include a new branch of teaching, named oral surgery and associated surgery, and Garretson was appointed to fill the chair. It was for both medical and dental students of the university. Later, other dental schools, following the lead of Penn, added oral surgery as an integral part of dentistry. Medicine was unwilling to embrace as a part of its practice any part of the services rendered at that time by a dentist. It would seem from contemporaneous and subsequent written statements of Garretson that he had no thought of connecting oral surgery with dentistry as a specialty. In the sixth edition of his book, he expresses the opinion that oral surgery is not a part of dentistry but that dentistry is a branch of oral surgery.

Garretson's attempt to establish a specialty of oral surgery in medicine was a failure owing in part to the adverse attitude of members of the medical profession and probably in part to the lack of interest shown in the specialty by medical students. The dental schools adopted the name "oral surgery" and made the subject a special branch of dentistry. Gilmer thinks that it "has stuck" there ever since, although he feels that it does not belong to dentistry. He says that the medical men with few exceptions recognized oral surgery as a specialty of medicine, and he has not

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been able to find the term "oral surgery" properly defined in any medical or general dictionary. He says that this may be due to the fact that so few men limit their work to the surgery of the mouth, jaws and face.

These opinions of Garretson and Gilmer are of great interest to us at this time. The manner in which oral surgery has been taught and practiced has not changed much in the past twenty years, and although oral surgery is a branch of general surgery, it is taught only by one or two of the medical faculties of American universities. I shall endeavor to discuss the reasons why it has not been and why it should be taught by the medical schools.

We have the terms dental surgery, oral surgery and maxillofacial surgery, or oral and plastic surgery. These terms were more or less carefully defined by the medical and dental corps of our army during the late war, and I think the foregoing classification may be of some use to us in our attempt to classify oral surgery. In the army, the term "dental surgery" seemed to imply the surgery of teeth and the investing tissues and was practiced by the surgeon having a dental degree. The dental surgeon was supposed to operate on and to treat fractures, cysts, benign neoplasms, epulides, diseases of the gums, extractions, including impactions, etc. The dental surgeon had for a teammate a general surgeon who was more or less familiar with plastic repair in general, and the two would work together on any case that involved more than the surgery of the investing tissues of the teeth. The dental surgeon constructed splints and immobolized the bony parts over which the general surgeon repaired the soft tissue. These maxillofacial teams were planned by Vilray Papin Blair, of St. Louis, and I had ample opportunity as his assistant in France to observe that they worked out exceedingly well.

The term oral surgery has a broader meaning and generally implies that the surgeon has the medical degree and is qualified to perform any operation within the oral cavity. He may operate on defects of the lips, palate, tonsils, buccal parietes, neoplasms involving the abovementioned parts, floor of the mouth, tongue and submandibular space. He is supposed to be a qualified surgeon who is especially interested in the surgery of the oral cavity.

Lastly, we have the maxillofacial surgeon, or the oral and plastic surgeon, who has the broad training of the general surgeon, but who has a flair for reconstruction work, who has had special training for the more extensive plastic cases and has imagination, courage and initiative to handle all types of plastic surgery in and around the face and neck. This work includes the surgery of the ears, face, scalp, nose, eyelids, lips, oral cavity and cervical region.

This classification is crude and inaccurate and is only arbitrary. It is given here in an endeavor to make a beginning.

I believe that oral surgery is a branch of general surgery, and not a branch of dentistry, and should be looked on as surgery, no more, no less. When I say that it should be taught in the undergraduate curriculum in dental schools, I suppose some will say that if it is a part of surgery, it should be taught in the medical schools. I would say in answer to this that it should be taught in both schools. Medicine, pathology, neurology and many other subjects should also be taught in both schools.

In the dental schools, our objective should be to train and develop men competent to perform and treat surgical conditions, diseases and injuries of the teeth

and the investing tissues; that is, we should turn out well qualified dental surgeons.

In the medical school, our objective should be to direct the surgeon's attention to the special requirements of mouth surgery. He should be grounded in the principles of general surgery. He should have special training in removing surgically large neoplasms of the jaws and in the special repair of defects of the lips and palates and the surgery of the sinuses.

Included in this course, there should be instruction in the principles of general surgery, corresponding to the surgical course given to the medical students in their second year. This course should be presented in the third year and should be followed by a more intimate course in the fourth year, dealing specifically with the following special topics:

1. Surgical anatomy of head and neck.
2. Bacteriology of mouth, surgical treatment, infection.
3. Anesthesia, local and general.
4. Disease and injuries of temporomandibular joint.
5. Fractures of maxillary bones.
6. Maxillary sinus diseases and neoplasms.
7. Cleft lip and palate defects.
8. Diseases and neoplasms of tongue.
9. Diseases and neoplasms of salivary glands and lymphatics.
10. Tetanus, actinomycosis, erysipelas, anthrax, tuberculosis and syphilis.
11. Lesions of buccal mucous membrane.
12. Neoplasms of jaws and buccal parietes.
13. Inflammation leading to dental abscess.
14. Extension of infection, caries, suppurative osteitis, necrosis of bone, repair and regeneration.
15. Stomatitis, pyorrhea, Vincent's infection.
16. Cysts.
17. Neuralgias, etc.

The course in oral surgery should be similar to the instruction given in surgery in any first class medical school. The clinical character of the work should be stressed. Lectures perhaps must be given, but these should be of an informal nature and should really amount to a talk or a conference, rather than the old cut and dried lectures of other days. The students should be assigned to work in the clinic one half of each day consecutively, for at least one month. There should be a weekly demonstration clinic where all important cases should be presented to the students by the students, after the latter have carefully worked up the cases. The students should be obliged to go into the wards to take histories, to observe dressings and to note the progress of patients. They should attend operations in the hospitals in small groups and be permitted to gather around the operating table, so that they can really see the operation and know what is actually being done. Most of the teaching of oral surgery should be done in the third and fourth years, and if we copy fairly closely the accepted methods that are used at this time in teaching surgery in the medical schools, we will do very well for the present.

As regards graduate training, a man must have a fairly good idea of the principles of oral surgery in order to enter on postgraduate work. He should have a fairly good idea of the anatomy of the parts. He must have a fair idea also of the pathology of this region, and he should have obtained some surgical experience before giving his time and taking the time of those giving the course. In other words, he should realize what surgery

means and should take a keen interest in this work before entering on a postgraduate course. If he has the foregoing, he probably has worked for quite a long period in hospitals and clinics and has shown in some way his interest and his zeal to become more proficient. He has made sacrifices in order to learn more about surgery. I do not think that it is wise, in other words, to permit a man to enter a postgraduate course in oral surgery who has not had the inclination and the determination to have previously spent much time outside his office in learning all that he can in institutions before taking this course.

I believe that there are too many men who take a course in this work who have been too busy to leave their practices in order to become familiar with the clinical side of this work before signing up for postgraduate work. If a man is serious in his desire to perfect himself in this field of surgery, he should have shown that his interests were along the right lines by working in clinics and giving much time to the treatment of disease, previous to the postgraduate course.

We cannot demand that our candidates possess any special degree, but we can make it compulsory for the matriculant to have shown himself ready and willing in preparing himself for surgical postgraduate work spending much time in clinics and hospitals.

Graduate teaching should be given in both schools. The young surgeon should have an opportunity to learn something of the special technic required in the surgery of the mouth, and the dental surgeon should have the chance to further perfect himself so that he may qualify as an oral surgeon.

It would be an excellent plan to make the teaching of oral surgery more nearly uniform in our schools, since much benefit has been derived from making the teaching of other subjects more nearly uniform in the dental and medical schools curriculum in the past. We do not wish to make our courses in any subject exactly alike in our schools, but in making them more nearly uniform, we might be able to bring up to a higher standard of teaching the weaker courses given in the weaker schools. To this end, I would say that it would be a splendid idea if a committee were appointed by this body to study the teaching given by the various schools of the country in oral surgery and to report back at our next meeting.

WHY ROOT CANALS SHOULD BE FILLED TO THE DENTINOCEMENTAL JUNCTION

By CARL J. GROVE, Ph.G., D.D.S., F.A.C.D., St. Paul, Minn.

IT has been frequently stated that the proper point to which root canals should be filled is the junction of the dentin and the cementum. It has also been suggested that the proper point at which the pulp should be severed is the point of its union with the periodontal membrane. It is my belief that the value of such a technic is of sufficient importance to justify a brief discussion of the merits of its procedure. The histologic character of the tissues composing the tooth structure constitutes the scientific basis of this technic.

Dentin is of a tubular nature, containing fibrils of the dental pulp, which decompose when disintegration of the pulp tissue occurs, causing infection of the contents of the tubules. It has been repeatedly proved that complete sterilization of infected dentin cannot be accomplished by the methods of treatment now in vogue. The method by which the remaining bacteria can be controlled consists in sealing the apical foramen, the only avenue for the escape of organisms present in the dentin. The cementum forms an impervious covering of the dentin, except the foramen. If the foramen is sealed at the junction of the dentin and the cementum, it will not be possible for bacteria present in the dentin to invade the periapical tissue; but if the root filling fails to reach this point, bacteria present in the tubules will have an opening to enter the adjacent tissue. Nutritive material from the surrounding tissue will be supplied to the bacteria present within the dentin, through this space. A more favorable condition for the production of infection could not possibly be produced. It appears to me that such a practice is extremely dangerous and should be condemned. Root canals might as well not be filled as to carelessly leave open spaces that will permit bacteria present in dentin to enter the periapical area. The purpose of a root filling is, first, to seal the foramen to prevent bacteria existing in the dentin from reaching the periapical tissue, and, secondly, to prevent fluids from entering the canal from the adjacent tissue; for a decomposition of this fluid will occur, since there is no possibility of absorption of substances in the canal of a pulpless tooth. As a result of this putrefactive process, infection occurs.

Figure 1 is a longitudinal section of a human bicuspid tooth of a youth, with the pulp present in the canal, and the membrane in the divergent foramen. It can be clearly seen that the tissue in the foramen differs from the pulp tissue in the canal, owing to the difference in the histologic character of these tissues. The junction of the pulp and the membrane can also be clearly seen. The periodontal membrane extends from gingiva to gingiva, either stretching across or folding into the divergent foramen, developing cementum to cover the entire surface of the root, cementum being somewhat

thicker at the apex, and thus forming the foramen. After the time of eruption, the root apex is developed entirely by the cementoblasts, the extremity of the root end being composed of cementum. The pulp does not extend into the area composed of cementum. If pulp tissue was present in that portion of the canal, dentin would have been formed in place of cementum. The pulp ends at the dentinocemental junction and should be removed at this point. It is my opinion that the most desirable results will be obtained if the pulp is severed at this position, and that the root canal should be sealed at the dentinocemental junction whether it be a case requiring pulp extirpation or otherwise.

I might state here that it is useless to fill root canals unless impermeable materials are employed; otherwise, bacteria will ultimately find their way into the periapical tissue, producing infection. Unless root canal operators recognize these facts, treatment of pulpless teeth will never be successful.

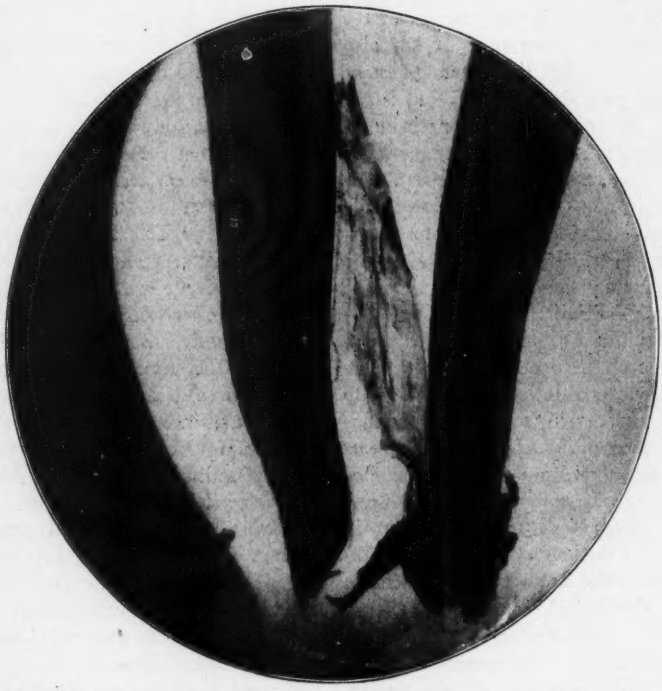

Fig. 1.—Longitudinal section showing pulp and periodontal tissue in canal. The pulp should be severed at its union with the membrane.

Disastrous results will also follow if the root filling extends too far beyond the dentinocemental junction, because of trauma of the tissue in the foramen, resulting in death of the pulp, followed by infection.

Figure 2 is another photomicrograph of a longitudinal section of a human tooth of a youth, showing the pulp in the canal and the membrane in the divergent foramen. There are some good reasons for severing the pulp at its union with the membrane. Pulp tissue is embryonic in character, and the repair of such tissue is always questionable. The process of healing is dependent on certain characteristics of the cells involved, and these qualities are lacking in pulp tissue. It is only by transformation of the pulp tissue into fibrous tissue that healing occurs, and such results will not follow when large portions of the pulp remain. There is always an element of uncertainty in this process of repair. The pulp does not possess the qualities of regeneration in itself. The fact that this organ lacks these characteristics indicates that it was not intended to function in this manner. Why, then, subject a tooth to a possibility of failure, when it is unnecessary? I question very much the successful application of the method, suggesting leaving 2 or 3 mm. of the pulp end; for atrophy is very likely to follow for reasons already given, and the resultant products of putrefaction find entrance by way of the open foramen to the periapical tissue, producing infection.

Fig. 2.—Longitudinal section showing periodontal membrane in divergent foramen. This should be preserved in root canal surgery.

I can see no justification for purposely leaving pulp tissue since there is no reasonable assurance of successful results. Well-developed tissue lies adjacent to this portion of the pulp tissue, possessing all the characteristics required for a most satisfactory repair of injuries of this nature. The dental literature is replete with conclusive evidence that the periodontal membrane will function satisfactorily if the pulp has been extirpated at this point. When all of the pulp tissue has been removed, the elements of failure are reduced; and it seems to me that we should employ the methods that offer the greatest possibilities of success; for one will have some failures even with the most scientific efforts.

That a definite junction of the dentin and the cementum exists is not questioned by those who have studied sections of root end tissue prepared for this purpose only. Sections selected at random may be misleading, because of distortion due to concavity or convexity of the surface of the root, as well as existing curvatures. One should not be misled by the presentation of such specimens. It is possible to prepare microscopic sections of any tissue so that the cells of the structure are not even recognizable.

That there are irregularities in the line of demarcation dividing these two structures is not questioned; but it should not be overlooked that any irregularity disclosed in a section is only a microscopic view, as only an extremely small area is shown under the microscopic lens. These findings do not prove that the remaining junction is not regular in its form. If a root is sectioned, say mesodistally, and some irregularities are disclosed, it does not prove that the irregularity would exist on the buccolingual surface.

Since the development of dentin precedes the formation of cementum, it is of course only natural that there should be a definite line of demarcation between these tissues.

It has been suggested that "it would be more accurate to speak of this as the area of the apical foramen and disregard the variable position of the junction between the cementum and dentin." Since it is known that it is possible to seal the foramen hermetically by filling to the dentinocemental junction, it appeals to me that such a point should always be the objective sought in order to eliminate as much as possible the elements of failure. The existence of irregularities of the junction does not signify that filling to the dentinocemental junction is impractical or impossible. Since it is known that bacteria will invade the periapical tissue when the filling fails to reach the cementum, it is folly to apply a technic that will fail to accomplish such results. With the promise of successful operations by this procedure, it should be the aim of every practitioner to make application of these principles. If the area of the apical foramen is used as an objective or the point to be reached, opinions as to the proper position are likely to vary greatly; for the conception of each operator differs as to the area of the apical foramen, if no definite point is designated.

It would not be practical to fill into the foramen, for the tissue in the foramen would thus be destroyed; which would prove disastrous, and if it were suggested that filling be carried almost to the foramen, the conception of the term "almost" would differ with each operator. A definite point should be specified in order to avoid overfilling or underfilling of root canals, and according to our present histologic knowledge, the only safe point is the dentinocemental junction.

TRIFACIAL NEURALGIA*

By L. W. SCHULTZ, B.S., D.D.S., M.D., Chicago, Ill.

MY subject, "Trifacial Neuralgia," is not a new one. Nor is it wanting for description in the literature. The symptom complex has been known for a long time and the treatment up to about twenty-five years ago was as varied as it was unsatisfactory and disappointing. We are greatly indebted to the scientific researches of men like Ostwald, and more especially to Schloesser of Heidelberg, for an advance in the treatment. This, the injection of alcohol, has persisted to this day, although fifty years ago injections intercepting the nerve trunks were made. Among these early workers are Barthlow, Billroth, Neuber, and later Bennett, using various drugs such as chloroform and osmic acid.

One of the lasting results of the work of Schloesser and Ostwald is a better understanding of different types of nerve pain involving the trigeminus.

My aim is to stress the importance of a differential diagnosis between that type of trifacial neuralgia in which the injection of alcohol is successful and any of the other varieties, often closely simulating the first type, in which the injection of alcohol not only gives no relief but also causes harm.

Mention should be made of the multiplicity of synonyms for this condition, such as tic, explosive tic, tic douloureux, major tic and trigeminal neuralgia.

The term "major tic" indicates that there must be another type of tic, not major, but minor. These two terms, which are of comparatively late coinage, give expression to the realization of a need for differential diagnosis, if the treatment employed is to be successful.

By major tic, that type of trifacial neuralgia in which no cause can be discovered, is meant. Any form of tic, therefore, with a discoverable cause is not major but minor tic, and successful treatment addressed to its etiology results in alleviation or cure.

The pathology of major tic is just as obscure as is the etiology. No known morbid anatomy exists. There are some theories, but they are untenable. Thus, Dana believes it to be a degeneration; Frazier thinks it a sclerosis, and both hold that the gasserian ganglion is affected. Their views have not been substantiated by sufficient microscopic findings. At the present time, therefore, we are still in want of definite data concerning both the etiology and the pathology of real trifacial neuralgia.

Causative factors in cases resembling trifacial neuralgia are: focal infection, secondary anemia, malaria, diabetes, tumors, nephritis, intestinal intoxication, syphilis, etc., which, when treated efficiently, cause the neuralgia to disappear. Infections of different parts of the head, such as nose and ear and mouth involvements, come under the same heading.

Dean,[1] in 1921, showed that glosso-

*Read before the Illinois State Dental Society, Springfield, Ill., May 14, 1929.

1. Dean, L. S.: Tr. South. Med. A., 1921.

dynia must be related to the nasal ganglion and is controllable by suitable injection of that ganglion. Sluder[2] reports seven cases in which he followed Dean's experience, with fairly satisfactory results. The sphenopalatine neuralgia, so-called by Sluder, involves the root of the nose, the eye, the maxilla, going to the ear, the occiput, the neck, the shoulder and even the arm; but this pain is not paroxysmal and is accompanied by pain in the throat. The inside of the nose also is painful. A topical application of cocain on the nasal mucosa near the sphenopalatine ganglion stops the pain. Most important of all are cases which come still more closely home; namely, cases concerning our own specialty, such as impacted teeth, pulp stones, incipient alveolar abscess and the like. Obviously, an alcohol injection could hardly be called satisfactory treatment for an alveolar abscess nor for any of the other conditions mentioned except glossodynia and sphenopalatine neuralgia.

While all the above enumerated conditions and many others may give rise to a symptom complex resembling major tic, the experienced diagnostician most always senses a difference.

The picture is not quite in harmony with that of major tic, and even before the operator addresses himself to the establishment of a definite etiology, he notes some discrepancy in the symptom complex, which puts him on his guard.

An attack of fully developed major tic once seen is never forgotten. It is characterized by a sharp, shooting, excruciating, lancinating pain, provoked by the most trivial irritation or occurring spontaneously. The muscles on the affected side react to this intense disturbance. The patient may throw his hands up to his face. He writhes in pain, and may tear at his hair, and there is lacrimation on the affected side. This lasts but a short time, disappears as suddenly as it started and leaves the patient absolutely free from discomfort until the next paroxysm. The frequency of the attacks varies. In the beginning, they may occur at long intervals, but soon they become more frequent, until they may torture the individual every few minutes. The course over which this pain travels is characteristic. It runs along the nerve trunk involved, always affecting the same territory. Usually, it is unilateral. The second division is most frequently embarrassed, the third division of the nerve being next in frequency. Fortunately for the patient, the first division is the one most rarely affected. There are cases in which two divisions seem to be involved. Thus, in an involvement of the second division the pain may radiate into the third or into the first, as when it appears in the supra-orbital branch. Usually, there are areas about the face supplied by the affected division, which, when touched, promptly cause a spasm of pain. This occurs most frequently at the corners of the mouth, but may be located any place in the mouth, on the face or on that part of the head supplied by the division involved. To these areas, Patrick has very aptly given the name trigger zone.

The diagnosis of major tic is made on the foregoing symptoms and on the absence of any discoverable cause.

TREATMENT

There is probably no other affliction in the management of which so many drugs have been used as in the treatment of trifacial neuralgia. Needless to say, the administration of these drugs was very unsatisfactory except in isolated

2. Sluder, Greenfield: J. A. M. A., 81:115 (July 14) 1923.

cases. Surgery relating to the peripheral branches, while offering temporary relief, does not cure; for, after a greater or lesser interval, the paroxysms return, because a new and usually larger nerve trunk develops after avulsion of part of the affected one.

To Hugh T. Patrick[3] belongs the credit of introducing in this country a treatment just as effectual as surgery, but far less formidable in its application. In 1907, he read a paper before the American Medical Association advocating the injection of 75 per cent alcohol for the control of this pain, as brought out through the researches of Schloesser, mentioned above. This became the universal treatment in this country, and Levy and Baudouin's method the usual technic employed. The time of relief from pain is practically the same as that obtained by the extirpation of part of the division involved; therefore, after the first successful injection, an interval of comfort varying from six months to two years may be looked for. After the second successful injection, an interval of about half the time obtained before may be expected; and so each time the period of freedom from pain becomes shorter and shorter, until further injections are of no more benefit. This, it will be noted, is a direct parallel to the surgical method mentioned above.

I have employed the alcohol method in various cases. One of my first patients, a salesman, was thinking seriously of having the sensory root sectioned, as he had had numerous injections without relief. I succeeded in relieving him for a year and a half, after an injection of the second division. When he returned, a repetition of the treatment resulted in a year's freedom, after which another similar injection gave him another year's rest. From then on, the time decreased to six months, then to five months, which has been the shortest interval to date. He refuses section of the root and feels quite happy with the result that he has experienced. In another case, in an Italian woman, I injected the second division more than two years ago and so far there has been no recurrence. A recent case, also involving the second division, showed a trigger zone immediately in front of the ear. An infra-orbital injection did not give full relief, but placing a few drops of the solution in the area of the trigger zone stopped the attacks completely. This was about four months ago, and I am reporting it because of the result. These are all cases of major tic, as the result of the treatment shows.

I will not take up your time by a recitation of case histories, but in passing I must mention the relief of a case closely resembling major tic in which there was no causative factor to be found. The patient was not entirely free between attacks. The paroxysmal pain subsiding, the affected part of the face remained the seat of persistent pain, gradually increasing in severity and terminating in an explosion, reverting to that persistent pain just mentioned. The attacks were of but a few days' duration. I practiced "masterful inactivity," and soon the picture changed to one of a dying pulp in a second bicuspid. The conventional treatment of the tooth resulted in a permanent cure. In another case, again a symptom complex almost caused me to decide the condition was major tic. Other symptoms, such as headaches and a secondary anemia, decided me to try intestinal and other elimination first, and this resulted in a complete cure. Relieving the patient of his anemia by appropriate remedies was

3. Patrick, H. T.: Treatment of Trifacial Neuralgia by Deep Injections of Alcohol, J. A. M. A., 49:1567-1574, 1907.

my next step, and he has remained well to date.

All cases which present themselves are not so nicely disposed of. I have at present a patient who, from her history, has never had major tic nor anything resembling it, yet all my efforts so far have been unavailing. As she has never had paroxysmal pains, relief could hardly have come through the numerous injections of alcohol that she had received before I saw her. She does not now complain of paroxysmal pains. In the effort to free her from focal infection, various things were done, her family physician, in cooperation with me, applying himself diligently to free her from all questionable sites of infection. I removed some buried roots and badly infected tonsils; the alimentary tract was looked after thoroughly, and all without avail. In the light of what has been done for her without giving relief, I suspect the symptom complex represents a neurosis, but that does not help her, nor does it point to a satisfactory method of management. I want to bring before you both my successes and my failures in the interest of candor and truthfulness.

Gasserectomy, while practiced before the advent of alcohol injection and while permanently abolishing the pain when successful, is so formidable an operation and so uncertain as to its outcome that other means of dealing with this intractable pain were keenly sought for. Spiller and Van Gehuchten recommended retrogasserian neurotomy, which Frazier first practiced in this country. This operation affords permanent relief and can be performed with a minimum amount of operative shock. It is usually done under local anesthesia and, while very exacting in its technic, does not require a long time in its execution. There are but a few men in this country really capable of doing this. Among them, Frazier is the most experienced.

As originally devised, a complete section of both sensory and motor roots was performed, but this has undergone some refinements. First, the sensory root was separated from the motor root and sectioned while the motor root was left intact. At present, experienced operators hold that they can and do separate the fibers of the first division and cut only those of the second and third division in the sensory trunk.

Still later, another form of treatment found its champions. Instead of section of the sensory root between the gasserian ganglion and the pons, Oljenick[4] describes a method which consists in the inhalation of 15 to 20 drops of trichlorethylene poured on a small piece of gauze or sponge. Fifteen minutes is consumed at each inhalation and it is used three times a day for from three days to a week. The patient should be in a recumbent position to prevent falling, because he may become giddy or even unconscious. In incipient cases, excellent and lasting results are reported. In chronic cases, recurrent attacks are usually less violent than before. A chemically pure trichlorethylene should be employed. Such a product is manufactured in Germany under the name of chlorylen. It has been used in the Peter Bent Brigham Hospital of Boston for more than a year. A similar product is made in this country under the name "gemalgene." The dose and method of administration is the same as that of trichlorethylene. While inhaling it, the patient should be under the observation of a nurse, and the treatment should be prescribed by the attending physician. The immediate effect of the

4. Oljenick, Ignaz: Trichlorethylene Treatment of Trigeminal Neuralgia, J. A. M. A., 91:1085 (Oct. 13) 1928.

inhalation is bilateral complete anesthesia of the tissues supplied by the sensory portion of the fifth nerve. This is a disadvantage, though minor of course, in view of the more or less lasting periods of freedom from pain that it affords.

ACUTE ORAL INFECTIONS: THEIR SEQUELAE AND CONTROL*

By DONALD M. GALLIE, Jr., D.D.S., Chicago, Ill.

IN selecting my subject, "Acute Oral Infections: Their Sequelae and Control," for this presentation, I am aware of the fact that most of us gathered here are interested in dentistry *per se,* that the large majority are engaged in a more or less general practice and that a paper, to meet the requirements, must contain elements of practical application.

During the past fifteen years, our thoughts and efforts have been largely directed toward the elimination of chronic oral infection and its relationship to general systemic health. The importance of this subject cannot be overestimated; nor can its beneficial results be scientifically refuted. Logically, the treatment of systemic disease of oral metastatic origin lies in the field of medicine, and although the dental surgeon plays a most important rôle in the last analysis, the physician must assume the responsibility for the patient's wellbeing and the progress of the case. On the other hand, because of their very apparent local manifestations, diseases of acute oral infection are of primary interest to the dental surgeon; and although systemic manifestations may present themselves and medical aid be obtained, the dentist or oral surgeon frequently finds himself held responsible, morally and legally, for the outcome of the case.

The seriousness of acute infections arising in oral and adjacent tissues cannot be overestimated, and their control calls for surgical ability, therapeutic skill and a knowledge of general and oral pathology and bacteriology. I believe that a discussion of this type of case is timely, and that serious thought and study of these virulent infections and violent inflammatory reactions may relieve the dentist from considerable embarrassment when such cases present themselves.

It is unnecessary to explain to a scientifically trained body of this type the differentiation between acute, subacute and chronic manifestations; but for the sake of clarity and unification of thought I shall endeavor to give you my understanding of the symptomatology and morbid anatomy of these acute infections. The type of case I wish to present for your consideration is that in which there has been an invasion by a virulent type of micro-organism and a more or less violent inflammatory reaction established in the tissues. The classic symptoms of rubor, calor, tumor and dolar (redness, heat, swelling and pain) constitute the local pathologic picture. Accompanying this, we find, in varying degrees, the general systemic ramifications of the disease

*Read before the Illinois State Dental Society, Springfield, Ill., May 14, 1929.

marked by fever, increase in the respiratory rate, variation of blood pressure, malaise, toxemia or bacteriemia, with associated leukocytosis; in fact, a general febrile state in which delirium, coma and death are sometimes the end-results.

The etiology of these acute oral infections are multitudinous, but those in which we are most interested are from peridental and gingival disease, dental root-end infection, trauma and abrasions of the soft tissues and organs of the mouth, maxillary sinus involvement and, in a minor degree, ear, throat, nasal and tonsillar infections.

It is needless to remind you that the seriousness of acute infection depends on the virulence of the organism and the ability of the host to resist invasion. The avenues for ramification and distribution of these acute infections are, first, the tissues because of their continuity; secondly, the lymphatic system and, lastly, the arterial and venous blood streams. Because of the histologic and anatomic relationship of the oral area, we have these factors working for our good or evil to a surprisingly marked degree in combating infectious processes.

It might be well at this time to consider the types of bacteria commonly encountered in these acute cases. Most often, laboratory examination reveals a mixed infection; and, almost invariably, we find the staphylococcus and streptococcus present (in all its variations and mutations, including pneumococcus), either as a primary or a secondary factor. *Bacillus catarrhalis, Baccilus influenzae,* the gas bacillus, the fusiform bacillus and the pseudodiphtheritic bacillus are often encountered, with the usual mixed pathologic and saprophytic flora of the mouth. The presence of the more unusual and more highly specialized bacteria, such as *Bacillus tuberculosis, Spirochaeta pallida,* the ray fungus of actinomycosis and Vincent's organisms, is pathognomonic and is usually indicative of distinct pathologic entities. Diagnosis of these cases may usually be made by laboratory analyses alone. In our laboratory bacterial technic, it is necessary to culture these bacteria by both aerobic and anaerobic methods. Again I wish to emphasize the importance of the streptococcus and staphylococcus as primary and secondary factors in these acute infections of the mouth; the frequency with which we find them as agents in cervical lymphatic complications, and their major effect in inducing general systemic bacteriemia and toxemia.

In our treatment of the acute cases, we are usually confronted by three major problems: (1) that which is purely local; (2) the care of adjacent tissues and structures, and (3) the control of the general systemic exacerbation. In all cases, we are confronted by these three phases in varying degrees of intensity. I believe it is well always to consider patients presenting acute infections as distinctly sick individuals. Inconvenient as it may be to a dental practitioner, it seems but logical that these patients should be confined to bed, especially if a variation from normal temperature is noted. Also, it is often wise to accept and request medical consultation. It will in no way detract from the dignity of our position and is often of advantage to the patient, ourselves and the profession. Hospital, laboratory and operating room facilities should be at our disposal, and our success will be in direct proportion to our ability to make use of these agencies.

The control of the local problem of acute oral infection is a simple one to state, but in practice it calls for a fine understanding of pathology and surgical

perception. Our activities must first be concentrated on the localization of the infective and inflammatory processes at a point of fluctuation. Dry heat, continuous hot moist compresses and hot isotonic irrigations are our most useful therapeutic agents in accomplishing this end. Patience is indeed a virtue when we are waiting for the consolidation of infection that is diffuse in the tissues, but its reward is bounteous when, by palpation, the diffuse infection is found to have broken down and centered in a definite localized phlegmon. When this has occurred, and by no means before, our procedure is to establish and maintain free and open drainage. Intra-oral drainage is at all times preferable if practicable, but this is many times not the case. I have noticed among many dentists a marked hesitancy to proceed when confronted by a problem where extra-oral drainage was indicated and obviously necessary. With ordinary skill and accepted surgical technic, the procedure of establishing extra-oral drainage seldom causes disfigurement for other than a limited period of time. On the other hand, its disregard or delay may contribute to the complications and sequelae of the case and often is responsible for deformity and functional impairment.

When patients come in with the ordinary acute infections of the mouth, it is an established procedure to start oral irrigation with hot isotonic saline or Ringer's solution, and in addition the application of external dry heat. With this procedure, a point of fluctuation is invariably noted in from twenty-four hours to three or four days. If, at the expiration of this time, it has not been possible to accomplish this result, it must be recognized at once that the case presents unusual conditions necessitating a change of therapeutic procedure. If a point of localized fluctuation is palpable, drainage should be accomplished by a generous incision in the mucosa and blunt dissection with a hemostat carried through the deeper tissue to the phlegmonous area. In both intra-oral and extra-oral approach, the use of the cigaret guttapercha tissue drain is preferable to gauze wicking for the maintenance of drainage, because of its mechanical advantages, its nonabsorbability of toxic byproducts and its compatibility with living tissues.

I cannot stress too emphatically the importance of the classic surgical maxim: "Never operate in the seat of an acute infection." Until drainage has been established and the tissues present a picture of chronic or subacute involvement, surgical procedure for the elimination of the infective source is contraindicated. There are cases in which the extraction of teeth in an acute infective process is simply the most effective means of establishing drainage, but these cases are rare and should be carefully selected. The factors of gravitation in drainage and the involvement of surrounding tissue must be taken into consideration. I do not believe that it is ever good surgical procedure to contribute an additional insult to already diseased and embarrassed tissue by trauma. I hesitate to open avenues whereby bacteria and their byproducts may enter the cardiovascular system, and I dislike to place an additional burden on the lymph nodes, which are already taxed to their utmost capacity in combating morbid processes. To illustrate the seriousness of this situation, I present a case history.

J. M., a boy, aged 16, admitted to St. Mary's Hospital in December, 1927, with an irrevelant history, forty-eight hours previous to hospital admittance began to suffer from an acute dento-alveolar abscess of the upper left first molar. Twenty-four hours

before hospitalization, the tooth had been extracted with some difficulty and trauma under a general anesthetic while still in the state of acute infection. The patient presented a marked hard, indurated cellulitis extending from the lower mandibular border to the temporal and orbital regions, associated with severe febrile reactions: temperature, 102 F., pulse, 104, respiration, high and irregular, leukocyte count, normal (8,700). An effort to localize the infection by the use of continuous hot moist fomentations was without success. Forty-eight hours after admission, the infective processes had, by continuity of tissue, extended to and invaded the deep fascia of the scalp from the frontal region to the occiput. Multiple incisions were made in this and adjacent areas and a seropurulent fluid exudate was obtained. The patient died of general septicemia and meningeal involvement, three days after admission. A mixed streptococcus and a gas bacillus were isolated by laboratory investigation. Necropsy revealed streptococcic meningitis and multiple metastatic involvements apparent in unassociated organs.

There are exceptions to all rules and these must be taken into consideration. We do find certain types of indolent infections and inflammatory processes in which it is markedly difficult to bring about the phenomena of localization. There are the types in which the reaction of the micro-organisms within the tissues does not coordinate in the process of pus formation. The reaction is low grade and indolent; yet these often contain the elements of highest potentiality for tissue involvement and toxic systemic saturation. It is with difficulty that this type of infection can be brought to a point of local fluctuation. The secretions obtained are often of a seropurulent nature and the tissues are in a degenerated and edematous condition.

It is not at all unusual, in cases in which we are unable to obtain fluctuation within the time limit by our therapeutic measures, to find that the infective processes have followed the lines of least resistance and have invaded adjacent structures, such as the maxillary sinus and nasal cavity. This condition calls for special therapeutic and surgical measures, chief among which are adequate drainage, irrigation, treatment of cellular degeneration and closure. The possibility of extravasation of pus between the bone of the maxilla and mandible and its tough fibrous periosteum, causing what is termed a subperiosteal abscess, should always be kept in mind in cases which do not react to the prescribed thermal treatment. In this instance, it is a mechanical impossibility for the byproducts of bacteria and tissue reaction to concentrate in a localized area. Instead, they follow the lines of least resistance, stripping the periosteum from the bone and causing a marked cellulitis over a large area. The destruction to bone tissue by this process, because of both the toxicity of the infection and the interference with the blood supply, is easily understood by those who have a knowledge of bone pathology. In the cases in which we cannot get localization in from four to five days, this possibility should be investigated. Here again, the treatment is threefold: evacuation of infective byproducts by incision and dissection to the bone surface, continuance of adequate drainage, and elimination of the causative factors of infection and of tissues broken down and destroyed by the processes of the disease after the acute symptoms have subsided.

CERVICAL INVOLVEMENTS AND SEQUELAE

With our knowledge of the lymphatic system in and about the head, it is easy to understand why so many cases of head infection present cervical complications. As part of the human defense mechanism, the lymph channels convey bacteria and their byproducts into the cervical lymph

nodes. Within ever seemingly abnormal limits, these tissues do their work of bacterial destruction and toxic neutralization to a surprisingly efficient degree. It is quite apparent that when acute head infections are present, these glandular tissues are taxed to their physiologic capacity. In acute inflammatory diseases about the head, lymphadenitis, with its accompanying inflammatory reactions, can and should be anticipated, and therapeutic measures should be instigated for the assistance of these glands in their activities. The possibility of the breaking down and the dissolution of these cervical lymph glands under stress is a complicating factor, which may be logically considered when their burden is in excess of their combative potentialities. In the treatment of these cervical sequelae to acute infection, we have again as our chief therapeutic agent the application of dry external heat and continuous hot moist compresses, the choice depending on the prognosis regarding the ability of the glands to resist the influences of infective invasion. To those of us who have the opportunity to observe a number of these cases, it is surprising how often, by the therapeutic application of heat, these glands are able to resist the tremendous burden placed on them, seemingly out of all proportion to physiologic expectancy. It is in these contingencies of cervical involvement that I cannot too strongly urge the greatest care and thought in handling the patient. Because of the seriousness of the local involvement, the systemic reactions and the anatomic relationship of the structures invaded, these patients should at all times be confined to bed. Local surgical and therapeutic measures should be initiated and vigorously pursued, and marked attention should be given to the systemic needs of the individual, such as control of pain, reduction of temperature, active elimination and stimulation of all physiologic processes entering into the resistance of infective disease. As I have mentioned before, it is surprising, when the local conditions of head infection have been placed under control, how often these lymph glands will overcome the burden placed on them and, when given half a chance, return to a normal physiologic state. A case history will illustrate the subject under discussion.

X, a girl, aged 15, admitted to the Lake County Hospital, with a negative history, a week previous to hospitalization had been suffering from an acute alveolar abscess involving both roots of a lower left first molar. Three days after the onset, the lymph nodes of the neck became markedly painful, indurated and inflamed and the entire left cervical area was edematous and involved. On admittance, the patient was suffering marked local pains and presented severe toxic symptoms. A previous unsuccessful attempt to establish drainage had been instituted by multiple intra-oral incisions, additional complications resulting. It is quite apparent that at this time the oral infection was potentially inactive and was centered in its entirety in the cervical regions. Because of the violence of the reactions and virulence of the infections, we believed that the lymphatic tissues could not withstand the invasion and their dissolution could be expected. Continuous hot moist compresses were applied to the area for a period of four days. Much to our surprise, the induration and inflammatory cervical reactions decreased daily, a physiologic state ensuing. After one week, in which progress continued, the infected roots were extracted under general anesthesia and the patient was discharged. Recovery was uneventful. It was found in this case that the tissues were capable of withstanding the burden placed on them, cervical drainage being unnecessary.

That these glands often do break down is a contingency which can be expected and anticipated. Because of the anatomic relationship of the muscles and of the deep fascia of the neck to the thoracic mediastinum, one can readily see the po-

tentialities for dangerous complications in these cases. In such cases, it is very important that the patient be continually confined to bed in order to defeat the factors of dissemination of infection by gravitation, as well as to obtain the benefits of inactivity and rest. Continuous hot wet compresses are the most valued therapeutic agent available because of their ability to concentrate blood at the affected part and to soften and relax the external tissues, with the result that the products of infection may find avenues of lowered resistance whereby they may proceed to the external surfaces.

In cases in which the cervical glands have broken down, it is also necessary to establish and maintain adequate drainage when a point of fluctuation is palpable even in the deep structures of the neck. After the usual preparation of an operative field, incision should be made in the skin at the point of lowest gravitation and blunt dissection with a hemostat should be carried into the deeper structures to the phlegmonous area. Drainage should be maintained by the use of guttapercha tissue or rubber dam drains and the external wound should be dressed. As soon as the condition seems to be under control, the sources of infection should be eliminated, and when drainage is complete, the external wound is allowed to close.

Somewhat closely allied with cervical adenitis, we find another important neck involvement as a sequel of acute infective oral disease; namely, cervical cellulitis, sometimes termed Ludwig's angina. I believe that this condition is also a cervical or sublingual involvement of acute head infection, usually brought about by invasion by continuity of tissue. In these cases also, we are confronted by a serious pathologic entity with all the troublesome factors attributed to cervical adenitis and a few peculiar to itself, including gangrenous degeneration, tissue dissolution and, in rare cases, edema of the glottis. These cases invariably present a picture of hard, indurated cellulitis in the sublingual area, many times of indolent type, and it requires a great deal of patience to continue treating them for days with hot moist compresses until they are ripe and ready for drainage. These cases also call for extra-oral interference. Many times, we have found it necessary to make long multiple incisions in order to drain the edematous and indurated tissues of their byproducts of infection when they do not resolve into a circumscribed area of liquefaction. The dangerous potentialities of all these cervical involvements cannot be overestimated and the mortality in these cases is a factor to be taken into consideration. It may seem to the general dental practitioner that the cases which have been presented at this time are rare, but such is not the case. It must be remembered that many of these operative procedures are precipitated into the medical or general surgical services of the hospitals and are not recorded as of dental origin or association, but somewhere in the picture there is usually a dentist or oral specialist who is carrying some responsibility and much blame, unless he is doing a major part to assist or institute treatment which will bring about a recovery of the patient.

I cannot leave the subject of acute oral infections without a word as to infections about the oral cavity involving the lips and adjacent external parts. According to clinical experience and the available literature, the prognosis of this type of case is discouraging and the mortality unusually high. According to a monograph published in a recent issue of *The Journal of the American Medical Association,* cases of carbuncle and acute

infection of the upper lip and external nasal part have been given a mortality rate of 40 per cent until a very recent date. In the control of this condition, the author advises early ligation of the external annular vein to prevent the possibility of a meningeal infection being carried by this vessel from the infected oral and nasal area. Because of the rich blood supply to the oral region, we have a factor which is of inestimable value in the success of our work; but by the same token we have a factor which, unless controlled, is a dangerous agent in the fulminating dissemination of acute infective disease.

I can but touch on some of the rarer and more specialized types of acute oral infection. Noma, or cancrum oris, a condition which, though rare, is at times encountered, calls for some endeavor on the part of the oral specialist to arrest its progress. Again, we are confronted by a bad prognosis. Most of these cases are fatal or leave the sufferer so disfigured that deformity and loss of function are the best condition for which we can possibly hope. I believe that the use of the actual cautery and radical surgery, such as is advocated for malignancy, are the only agents indicated and these offer only a faint hope of even slight success.

In the treatment of acute local oral conditions, the factor of actinomycosis must always be kept in mind. Because this disease often simulates the ordinary alveolar abscess at its onset, it calls for a careful diagnosis. Here also is presented a picture of a very painful, indolent infection, causing marked cellulitis and induration, later breaking down with devastating tissue destruction, and leaving in its wake marked deformity and functional impairment. The diagnosis of this disease is a laboratory procedure. The microscopic isolation of the ray fungus *in toto* or in part will indicate to the practitioner the nature of the disorder. Free and open drainage of the area, irrigation with copper sulphate solution and the use of potassium iodid for systemic medication to a point of tolerance will usually control the acute phases of the disease.

No paper on this subject presented before a purely dental audience would be complete without a word on the subject of Vincent's infection. The diagnosis by microscopic examination is familiar to all practitioners, and the pathologic process is recognized by any observant stomatologist. It is a disease of marked prevalence in recent years and can almost be considered pandemic. Every one of us encounters it almost daily in our practice, but I doubt that many consider its potentialities for serious involvement. Fatal and complicated cases are by no means rare. Involvement of the entire oral mucosa, including the pillars and pharyngeal tonsils, is not unusual; death from edema of the glottis has in many cases been recorded, and dangerous toxic reactions must always be considered within the realm of possibility. As cervical involvement of mixed infections superimposed on this disease has often been recorded, let us view all these cases in terms of their potentialities. The patient can always be considered a definitely sick individual at the onset and should be treated as such and given unusual care from the standpoint of general systemic hygienic treatment. Any of the accepted local therapeutic agents may be used to advantage.

In my work, I find the use of oxygenation by the reaction of hydrogen peroxid upon cromium trioxid, as advocated by Hardgrove of Fond du Lac, Wisconsin, to be the most successful local therapeutic procedure. Local and intravenous

medication with neo-arsphenamin seems to give excellent results in cases in which marked toxemia is encountered or the infection is invading remote tissues, organs and structures.

As a final procedure in the control of acute oral infections, I believe it wise for the practitioner to consider well the possibilities of pulmonary involvement. The mouth and adjacent organs being an integral part of the respiratory system, it is most apparent that these infections can be readily transmitted to the lungs and bronchial structures. In cases of war injury sent into the maxillofacial departments, I believe that death from pneumonia was second only to hemorrhage and shock. In addition to the danger occasioned by these infections, we have the risk incidental to general anesthesia when its use is necessitated. Daily and continuous oral hygienic care should at all times be instituted in dealing with infection of primary or postoperative origin.

This paper has been concentrated on a subject that is in the broadest sense, to all intents and purposes, of interest to the dental profession. The true general practitioner of dentistry cannot confine his activities to operative, prosthetic, surgical or office therapeutic procedures alone. Whether we wish it or not, there are times when bedside and hospital attendance is required of us. There are times when medical consultation is invaluable and decidedly necessary, but this fact does not necessarily release us from definite responsibilities and obligations. Our knowledge, education, experience and entire professional ability are at stake in these serious cases. Our medical and surgical confrères have a definite right to take for granted our ability to cope with situations involving the mouth and adjacent part. They should be given every reason to believe that our training gives us an understanding of the problems that are distinctly theirs. With such responsibility vested in the dental surgeon, hospital, laboratory, operating room facilities and all recognized therapeutic agencies should be readily at our disposal. Carefully prepared case histories, general physical examinations, laboratory analyses, in fact a comprehensive understanding of medical, biologic and surgical procedures, must of necessity be part of the general practitioner's equipment.

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RESPONSIBILITY OF THE DENTIST FOR THE HEALTH OF HIS PATIENTS*

By A. W. BRYAN, D.D.S., F.A.C.D., Iowa City, Iowa

WITHIN the past few years, the dental profession has assumed a new relationship to the field of health service. Many of us in this group received a dental training that limited our interest and responsibility to the distal surface of the third molars and the soft tissues adjacent thereto. It was difficult for us to conceive how the mechanical work that we were called on to do in the oral cavity could have any connection whatsoever with degenera-

*Read before the Illinois State Dental Society, Springfield, Ill., May 14, 1929.

tive changes which might occur in tissues remote from our field of operation. But we were suddenly awakened to the fact that the results of our work are not confined to the mouth, and that we can no longer base our diagnoses on oral conditions alone. The dentist does have a definite responsibility to his patients in recognizing the systemic effects that may result from his operations on the oral tissues and the diseased conditions that may already be present and which are due to work that has been previously done.

How many patients who come to the dentist are in good health? To answer that question, it will be necessary to determine what good health is. Health has been defined as that condition in which all of the tissues of the body are maintaining their integrity of structure and functioning within physiologic limits. There is much opportunity for debate as to what "physiologic limits" means, but we do know that nature permits very little variation from the accepted normal in most of the physiologic functions. Several degrees variation in temperature or a slight variation in some of the chemical constituents of the blood gives rise to alarm and a search for the source of the trouble.

If we are to give credence to figures obtained by the medical department of the U. S. Army during the World War draft, we must admit that many of the patients who come to us for dental treatment and advice are not in good health. A few statistics from the report of provost marshal, Gen. E. H. Crowder, for 1918, will be of interest and furnish much food for thought. He says that of 1,366,142 men available between 18 and 45 years of age, 437,378 were rejected. Out of 2,568,012 between 18 and 22 years of age, 770,403 were rejected. From all classes, representing 3,604,626 men, 1,205,781 were rejected as unfit for military service, many of them seriously broken in health.

Eugene Lyman Fisk, medical director of the Life Extension Institute of New York, after an extended statistical analysis, concludes that the total rejection rate for physical reasons would lie between 30 and 40 per cent, and the rate at the most favorable age group is from 25 to 31 per cent.

It is interesting to compare these figures with those of the British Army during the same war. The British Military Committee summed up its conclusions on British vitality as follows: "Of every nine men of military age in Great Britain, on the average three were perfectly fit and healthy; two were on a definitely infirm plane of health and strength; three could almost with justice be described as physical wrecks, and the remaining man as a chronic invalid."[1] If these statements are true, and I see no cause to doubt them, from 30 to 40 per cent of the patients who walk into our dental offices have tissues "which are not maintaining their integrity of structure and functioning within physiologic limits." How many of us as practicing dentists are making any effort to determine which of our patients belong to this group, and are allowing our findings to govern our diagnoses in their cases?

I would not be understood to infer that in all of these cases as reported by the War Department, there were degenerative tissue changes, but this was true in many of them, and it is reasonable to assume that many were due to infection. Neither would I deny that diet might play an important part in the condition of many of the rejected men. But even

1. Wiggam: The New Decalogue of Science.

with the most liberal allowance for diet and other factors, we must come back to the presence of chronic infection as a frequent cause of deranged health.

We, as a profession, cannot avoid the responsibility that we have in recognizing the symptoms of ill health in our patients. We must search for and remove any possible dental cause and, furthermore, must avoid creating other conditions that may later become a source of infection.

The relation between oral infection and systemic disease is firmly established, despite an organized effort within the profession to minimize its importance. There should be no sympathy with the dentist or the physician who, by ridicule and sarcasm, tries to give the impression to groups of dentists that oral infection is a thing to be looked upon lightly. Many men have left conventions where this attitude has been taken and have returned to their practices with a false sense of security on this question. As a result, they have left very serious sources of infection in their patients' mouths, and they justify their action by the fact that "so-and-so" said "it is all bunk." I believe that the men who dismiss the seriousness of focal infection by the wave of the hand and a caustic remark have much to answer for in the matter of the health of many people. Let us admit the reasonableness of the relationship between oral infection and systemic disease and take at face value the evidence that has been presented in proof. If there is any doubt in an individual case, let us give the patient the benefit of that doubt and admit that health is the most important factor in the whole problem.

When oral focal infection was first brought to the attention of the dental profession, we were prone to look only upon the serious systemic diseases as being related to it. Unless the patients were badly crippled with arthritis, suffering from serious heart lesions, gallbladder infections, eye lesions, etc., we did not consider that the injury was coming from the dental foci. The fact that we were unable to bring about cure or relief in every patient caused many to believe that there was no connection in these cases. It would require a most optimistic mind to believe that a heart valve, showing a definite structural change, or a joint that had been deformed by calcic deposit, could be restored to normal by removal of the source of infection that may have been responsible for the condition. But that is no valid reason for leaving the original source of infection to cause further lesions and to affect the general health of the patient in other ways. We now believe that, in many cases, mild changes begin to occur in certain tissues of the body, and mild subjective symptoms appear long before serious degenerative involvement takes place. Here the responsibility of the dentist is greatest. These symptoms indicate a beginning break in health. The medical man does not get to see these patients because most of them will not call on their physician until conditions become severe, and it is then too late. It is up to the dentist to look for these changes and make a careful search for any dental condition that may be responsible.

It is the purpose of this paper to discuss some of the symptoms most frequently met and seek to find a relationship between them and oral disease. In a series of 333 cases studied in the infirmary at the University of Iowa College of Dentistry, many interesting conditions were found. In practically every one of the cases, the patient carried potential locked infection in the form of

pulpless teeth. They were examined for changes in blood as related to total cell count, differential white count and hemoglobin content. In a few cases, calcium determinations were made. Certain changes were found to be fairly constant in the blood pictures of patients who had been carrying pulpless teeth, these changes occurring soon after the teeth were removed. In most cases, the change was toward the accepted normal of health.

Among the subjective symptoms noted, we found that 61 per cent of the 333 patients examined complained of lassitude. Fifty-two per cent complained of nervousness, ranging all the way from mild irritability to nervous breakdown. Judged on the basis of work done in recent years by investigators in the field of biochemistry and medicine, this condition of nervousness links itself with focal infection in a most logical and interesting way. There is no dispute that certain mineral constituents of the blood control the stability and tranquility of the nervous system. Berman, McCleod, Collip and many others have stated that calcium exerts a depressant effect on nervous tissue. When the normal level of the calcium in the blood is lowered, we get increased irritability of that tissue, and the patient develops nervous symptoms. It has been repeatedly observed that there is a decrease in the blood calcium in the presence of chronic infection. Vines claims that calcium is bound up with the toxins elaborated from the bacteria in order that they may be eliminated; hence, we get lowered blood calcium.

We have observed that many patients who exhibited these nervous conditions experience a marked increase in irritability after surgical interference in infected areas. Theoretically, this would be due to the rapid absorption of toxin from the wound and the resultant call for added calcium to cause its elimination. After a few hours, the symptoms subside and the patient gradually improves. On the basis of present knowledge, it would seem that the interest of the dentist should be thoroughly aroused in patients complaining of nervousness. There of course may be many other causes but we are responsible for finding the dental connection if it exists. We have records of one patient presenting this picture in whom the ionic calcium increased 2 mg. per hundred cubic centimeters of blood, after the removal of pulpless teeth.

A common complaint of patients carrying dental infection is their inability to think clearly or concentrate on what they are reading. There seems to be a mental haze or cloud. This condition could be very logically linked up with a symptom frequently found in these cases —lowered hemoglobin. In the 333 patients examined, the average hemoglobin was 65.3 per cent (Dare). This seems alarmingly low when we consider the important functions of hemoglobin in the vital processes of the body. In previous papers, I have quoted from an article by Lieut. John A. MacCready, famous aviator, which appeared in an issue of *Liberty* a few years ago. His experiences illustrate the point so well that I make use of that quotation again. In telling of his attempts to set an altitude record in a plane, he recites his experiences with the severe temperatures encountered at extreme heights. He says:

> Severe as such cold is, it is more easily endured than the lack of oxygen. When a flyer reaches an altitude of about 20,000 feet, a peculiar depression attacks him, the sky looks grey and dreary, a queer lassitude takes possession of him, and his faculties are greatly slowed up. He inserts the oxygen tube in his mask and with a few deep breaths

the whole world brightens. He is a different man, ready to think and act quickly. . . . It is certain that if there is another war, flyers will fight on oxygen and the contest to reach the highest altitudes will become important. The pilot with the most efficient oxygen supply will be the clearest of mind and the quickest of action.

How well Lieut. MacCready has described the symptoms of the patient with chronic infection and the resultant lowered hemoglobin-lassitude, a pessimistic outlook on life, a mental haze! In the aviator's case, the brain was robbed of oxygen because it was not brought to the lungs to be delivered; while in the patient's case, it is brought there and cannot be delivered. The end-results are the same. Furthermore, the effect on the metabolism of a lowering of hemoglobin should not be lost sight of.

A case history illustrating the changes that may take place in some of the above mentioned symptoms, after the removal of foci of infection, follows:

A woman student, aged 27, complained of lassitude, nervousness and inability to concentrate on her work. She said that while her roommate could read a lesson over once and have it, for herself three or four readings were required and even then she often wondered what it was about. She had three pulpless teeth and her tonsils were in such condition that her physician advised their removal. Her ionic blood calcium was seven mg. per hundred cubic centimeters. After the removal of one of her infected teeth, she had a severe nervous reaction, becoming almost hysterical. These symptoms were not feigned, for she was a good, sensible patient at the time of the operation. We assumed that the reaction was due to a sudden absorption of toxins and a further disturbance of the already lowered blood calcium. She gradually regained her nervous equilibrium, and after the dental operations were completed, her health improved noticeably, up to a certain degree. All of the subjective symptoms practically disappeared, but the blood picture was not quite normal. The hemoglobin at the beginning was 70 (Dare), and this is significant when we consider her mental haze. After the dental operations, she had her tonsils removed, and recovery was complete. The hemoglobin went to 83, the blood calcium to 9 and the differential blood count to normal. Two years later, the picture was still the same. She came to us, unsolicited, and said that she thought we would be interested to know of her progress in school. During her first two years in school, when she was carrying the infection, her scholastic record had been very mediocre, but in the last two years her ability to study and retain her work had been so markedly improved that she was being considered for election to an honorary scholastic organization.

Are these things worth while? Are we to wait until serious degenerative changes occur before we consider dental infection as a source of trouble? This patient had nothing structurally wrong, at least seriously, and it would have been easy to tell her that her dental condition probably had nothing to do with her nervousness and mental laziness. The line of least resistance is not always the best line to pursue.

Another change that is important and that usually accompanies chronic infection is the disturbance of the cellular elements of the blood. It has been noted by many investigators that a change in the proportion of polymorphonuclears and small lymphocytes is likely to occur in this condition. At a meeting of the American Dental Association in Detroit I made a report on a series of tests to determine what changes occurred in the blood picture after pulpless teeth were removed. In forty-one patients who returned for observation, we found that there was an appreciable improvement. Among other changes, there was an average increase of 10 per cent in the hemoglobin, and that is significant as related to conditions discussed in an earlier paragraph.

Most investigators consider the average number of polymorphonuclears as 70 per cent of the total white count,

and the small lymphocytes as 20 per cent. A variation to a slight extent either way cannot be called pathologic; but when the variation becomes marked, there is certainly some abnormal factor at work to bring about the change. The question might arise as to the importance of maintaining the normal polymorphonuclear level. When we come to consider that these are the cells that are credited with aggressive defensive action against acute bacterial invasion, it would seem logical to assume that maintaining them in proper numbers is important. We know that, during acute infections, there is a marked increase in the total number of white cells and the greatest percentage of increase is in the polymorphonuclears. In the case of chronic infection, the very fact that the abnormal picture starts to return to normal and the patient's general condition improves, after the removal of the infection, would tend to indicate that there is a relationship between the two.

In the forty-one cases, the average polymorphonuclear count before the infection was removed was 62.2 per cent. The last count after the teeth were removed showed an average of 66.8 per cent—rapidly approaching the accepted average of 70 per cent. The small lymphocytes changed from 25.7 to 23.5 per cent. Some of the individual cases showed marked changes.

To determine that the favorable changes in these cases were not due to seasonal benefits, since the first counts were made in the late fall and the last in late spring, a group of controls were used. The controls had the first counts made at approximately the same time as the active group, but they did not have their pulpless teeth removed. Any factor which operated to cause change in the active group would also be operative in the control group, with the exception of the removal of foci of infection. The polymorphonuclears in the control group averaged 59.8 per cent to begin with and in the last count averaged 61.7 per cent; practically no change, and still far from the accepted normal. The small lymphocytes were 28.7 per cent at the start and 28.4 per cent at the completion of the test. Since the beneficial changes did occur in the active group and improvement in general health was concurrent with the changes, it requires no stretch of the imagination to believe that chronic dental infection is very frequently the cause of some of these mild symptoms that are so frequently met.

The following case reports serve to illustrate the marked improvement in some of these cases:

Mrs. J, aged 35, complained of nervousness, lassitude, and pain in the neck and shoulders. She was scarcely able to carry on her housework because of extreme lassitude. The hemoglobin is 35 per cent (Dare). (Is it any wonder that she gets tired when we remember the experience of Lieut. MacCready when he lacked oxygen?) Polymorphonuclears numbered 62 per cent and small lymphocytes 31 per cent. After the removal of her pulpless teeth, there was a progressive improvement in all symptoms. In four months, the polymorphonuclears increased to 67 per cent and the small lymphocytes decreased to 22 per cent (practically normal). The hemoglobin increased to 68 per cent and the blood therefore had double the oxygen-carrying power that it did when the infection was present. The patient looks very different and has changed from a pessimistic invalid to an alert, cheery individual. When she was last seen, a year after the work was completed, she was still in improved health, even though she had passed through a severe nervous and mental strain because of the death of one of her children.

Another case illustrates a point brought up in the early part of this paper. We cannot expect to change tissue back to normal after a definite structural change

has taken place. The patient who is crippled because of a proliferative arthritis will remain so, even though we remove the original cause. But often we can improve the general health of these patients and make life more comfortable and enjoyable by removing the cause of some of the minor symptoms.

Miss S, aged 26, had one pulpless tooth, which showed no reaction in the periapical tissues. Her physician had told her that she had a leaky heart valve. She complained of extreme lassitude, shortness of breath and nervousness. When it was found that the hemoglobin was 50 per cent, the presence of lassitude and shortness of breath were not surprising. Not only was the blood deficient in oxygen-carrying power: it also was not well circulated, because of the defective heart. The polymorphonuclears were 58.5 per cent, the small lymphocytes, 27.5 per cent. With no thought that the removal of a potential source of infection in the form of one pulpless tooth would ever remedy the structural change in the heart tissue, but with a realization of responsibility in considering dental infection as a most probable cause of some of the other symptoms mentioned, removal of the tooth was recommended, a procedure well justified by the results obtained. Within two months, and without medication of any kind, the hemoglobin increased to 70 per cent and the polymorphonuclears to 65 per cent, and the small lymphocytes decreased to 25 per cent. Twenty per cent increase in hemoglobin was 40 per cent of what was already had, and thus the oxygen-carrying power of her blood was increased by 40 per cent. The subjective symptoms improved markedly.

My plea, then, is for every member of the dental profession to assume to the limit his responsibility in the field of health service. We see these patients at the time the mild symptoms appear, long before the physician is called. We should not ignore these changes. In many cases, they are nature's warning of a disturbed function which, if allowed to continue, will result in serious systemic involvements and degenerative changes, which will not improve, even though the original cause be removed.

I believe that the profession is recognizing and assuming its rightful place, because we are constantly seeing evidence of more careful diagnoses by its members.

THE RATIONALE OF DENTAL THERAPEUTICS*

By GERALD D. TIMMONS, Ph.G., D.D.S., Indianapolis, Ind.

ONE of the most difficult things to understand is why certain remedies are accepted and used in the office of the ayerage dentist. It is the age-old question of rationalism versus empiricism. In other words, the rationale of the various remedies is not being considered as it should be. "Rationale" means a series of reasons for a given opinion or process; and we should have reasons for using every remedy employed in our offices. These reasons should be founded on scientific facts rather than upon hearsay and written advertisements, and it is indeed an indictment of the dental profession as a whole to have drugs accepted for use as they are in the average dental office. In the majority of instances, no thought of rationalism enters into the choice of remedies.

*Read before the Illinois State Dental Society, Springfield, Ill., May 14, 1929.

Our therapeutics is divided into two classes: rational and empiric. Rational therapeutics is that branch in which we have a knowledge of the existing pathologic conditions and know that the physiologic action of the accepted drug or drugs will counteract these known pathologic conditions. Empiric therapeutics is that branch in which we employ drugs with only a knowledge gained from clinical experience. This type of practice is wrong, and we could offer but a very feeble defense if we were called before a jury of our peers to explain why we had used a drug simply because we had read or heard that it had cured cases which might have or might not have been similar to the one in question. This is the type that is mainly in use today.

We should know, for our own sake and for the sake of the patient, the action, indications and contraindications of every drug that we ever prescribe or use. But how many of us do? Of course, it would be next to impossible for us to carry all of these in our minds, but we have or should have access to textbooks and, further than that, we should use them. How often have we prescribed a tablet or capsule to help control postoperative pain, not knowing the composition of the medicament? Many times, with absolutely no thought but that it would be "all right." Then, too, how many times have we prescribed some tooth paste or mouth wash simply because we liked the way the picture was painted by the advertisement, the specialty man or the circular in the package? We never stop to consider that all of these products are for sale and are painted in the most favorable colors in order to foster their sale. There is only one thing which prevents these manufacturers from painting a far more rosy picture, and that is the Pure Food and Drug Act.

Time was when these companies were allowed free rein in their advertisements and in their labels. Claims were made for these various products which, if they were true, would make disease a myth. All this has changed, and the law holds a firm check on these manufacturers, thus protecting us and our patients. But the English language may be handled in various ways; the circulars, advertisements and labels may be within the wording of the law, but at the same time the idea may be conveyed that miracles are not altogether impossible. It is most interesting to read some of the details of the fight that was waged in order to bring about the passage of this law, and too much credit cannot be given Dr. Wiley for his efforts.

It is true that all proprietary remedies are not humbugs and fakes. We have had many introduced that are based upon rational therapeutics, but we have had others that attempted to "get by" with claims that are ludicrous. In the first place, let us understand the difference between a proprietary remedy and a "patent" medicine. A proprietary remedy is usually considered as one which is placed on the market by a reputable pharmaceutic house, this house having the sole right to manufacture the preparation. The formula is known, and no attempt at secrecy is made; neither are there any extravagant claims made as to its superlative qualities. A "patent" medicine is one put out by a company having the sole right to prepare and sell the preparation. Usually, the name alone is patented, the formula for the compound remaining secret. It is these secret formulas that we should avoid. Often, the patent medicine maker publishes a partial formula or gives the name of the

drug which is supposed to exert the powerful influence; but unless they are willing to deal openly and above board, there is no reason for us to accept their statements blindly and to use their product when there are so many available which are not enshrouded in secrecy. It creates a much better impression for us to write a prescription than to instruct the patient to stop at the drug store and buy some of the patent medicine.

Lately, the American Dental Association has been performing a service which is invaluable to us. Every month, THE JOURNAL has a report from the Bureau of Chemistry giving us the facts in regard to these preparations. If this practice is continued, it will do much to help separate the sheep from the goats in our present patent medicine problem.

To be a little more specific: In running through a standard current dental periodical which reaches all of us, we find the following remedies advertised: Campho-Phenique, Mucol, X-It, Vince, Sal Hepatica, Absorbine, Jr., Semafor, Tartaroff and Ora-Noid. It is rather interesting to read the claims that are made for these preparations and then to read the history together with the chemical analysis of them. I shall attempt to give you some of the claims made for these products and then give you the results of the analysis as made by the Bureau of Chemistry of the American Dental Association and the Bureau of Investigation of the American Medical Association.

The advertisement for Campho-Phenique says that it is a notable germicide, an efficient antiseptic, a nonirritant, a decided local anesthetic, insoluble in water and glycerine, does not discolor or stain, is possessed of an agreeable odor and not a disagreeable taste, and maintains an unchanged integrity. It is recognized as wonderfully adapted to a large proportion of dentopathologic conditions, from sensitivity of the dentin through the varying conditions of pulp irritation, pulp devitalization, pericemental irritation, alveolar abscess and caries or necrosis of contiguous osseus structure. Surely, these claims, if they were true, would make this an all important medicine in our cabinets. But this is what *The Journal of the American Medical Association* has to say:

> Essentially, the product Campho-Phenique is a solution of camphor and phenol in liquid petrolatum. These are substances well known in medicine and dentistry none of which under its own name has ever been credited with possessing the powers given it by the claims in the advertisement. Claimed to be a compound of phenol 49% and camphor 51%. Investigation of purchased sample showed it to be not over 20% phenol and instead of 51% camphor it contained not over 38%. Besides these, a third substance was found which proved to be liquid petrolatum and present to the extent of 38% or more. The preparation could hardly be expected to do all of the miracles claimed for it.

Another greatly advertised remedy is Sal Hepatica. The advertisement in this periodical was worded thus:

> How Sal Hepatica helps correct oral acidity and thick ropy saliva. Acidity of saliva and gingival degeneration are often the results of disturbed metabolism. Thus to correct oral acidity and the thick ropy saliva that accompanies it, bodily functions must be kept in good working order and the normal vigor of the kidneys, liver and intestines must be restored. Sal Hepatica, the standard effervescent saline, is recommended as an aid in correcting oral acidity. It is the approved treatment to alkalize the system. It stimulates the absorptive, excretory and motor functions of the alimentary tract, accelerates the removal of waste products and systemic toxins, thus maintaining a more healthy blood stream.

Their advertisements used to read that Sal Hepatica is the most powerful solvent of uric acid known, and also declared that diabetes is treated with decided advantage by means of Sal He-

patica as it possesses the properties of arresting the secretion of sugar in the urine. It is advertised to the public as an aid in elimination in gout, rheumatism, bilious attacks, acute indigestion, a catarrhal condition of the stomach, dizziness, heart burn, summer complaint, derangements of the stomach and liver, skin diseases, colic and alcoholic excess and as a preventive of seasickness. Surely, this covers enough territory.

The *Druggist's Circular* published the following formula of Sal Hepatica, as it never was given to the public by the manufacturers: sodium phosphate, 29.80 parts; sodium sulphate (Glauber's salts), 26.27 parts; sodium bicarbonate (baking soda), 18.00 parts; sodium chlorid (common salt), 13.05; lithium phosphate, 0.04 parts, and citric and tartaric acids, 12.84 parts. "Sal Hepatica, then, is a simple effervescent saline laxative, essentially secret in composition and sold under claims that would be laughed at were the full formula of the product a matter of public knowledge."[1] How much better it would be for us to prescribe some simple saline laxative such as effervescent sodium phosphate, which is an official preparation, than to place our trust in such a compound.

The next advertisement to catch the eye was the one for Tartaroff. The manufacturer has this to say about his product:

A marvelous discovery for the teeth. Makes them white as snow. Tartaroff acts like magic on the teeth. It instantly removes all tartar, film and spots caused by tobacco, nicotine, fruits, vegetables, medicines or ugly discolorations. Tartaroff makes old yellow ugly teeth glisten like polished ivory. Tartaroff is the greatest discovery of the age. Nothing like it ever presented before. It is not a tooth paste but a simple harmless preparation that can be applied to the teeth in a few seconds. Immediately the teeth are transformed into gems of pearly white beauty. Tartaroff will not injure the most delicate gums, enamel, gold, silver or other fillings. Makes your teeth pearly white in the magic of a moment. Tartaroff is guaranteed to remove tartar, film, nicotine and all ugly stains from your teeth. Dampen tooth brush or cotton swab with Tartaroff freely, rub teeth briskly, then use tooth paste as usual.

Examined by the American Dental Association Chemist, Tartaroff showed a p_H value of 1.0. Seven is neutral and all below that figure is acid. Qualitative tests indicated the presence of hydrochloric acid and a minute trace of aluminum. Fluorids, phosphates, sulphates, oxalates, nitrates and other metals were not found. Quantitative tests showed total solids, .68 per cent; ash, 0.008 per cent, and hydrochloric acid, 1.23 per cent. Using this analysis as a basis, we may make a product having the properties of Tartaroff by adding 3.5 c.c. of hydrochloric acid U. S. P. to 100 c.c. of water and then adding a small amount of coloring matter. The claims for this product are absurd. To think that you may swab the teeth with a solution of hydrochloric acid and not injure them. There are many other acid preparations on the market, and many dentists use them instead of the regular recognized prophylactic procedures, much to the detriment of their patients.

Mucol was the next product by which the human race was to be saved. It is recommended as a mouth wash; for the discomfort of mouth and gums resulting from wearing artificial dentures; after extraction of teeth; for nasal application; as a throat gargle; after smoking, tongue burns, etc.; after shaving; for superficial scalds, tired, tender, troublesome feet, prickly heat and sunburn; for sponge baths, and as a vaginal douche.

1. Propaganda for Reform, J. A. M. A., 77:1438 (Oct. 29) 1921.

"Thousands of dentists use and recommend Mucol as a treatment." Now let us see what *The Journal of the American Medical Association* had to say about it: "Specimen examined was a white powder and from the odor, thymol, eucalyptol, camphor and oil of wintergreen could be recognized. Qualitatively sodium, chlorid and borate were found. Quantitatively sodium chloride was found to amount to 47.2% and sodium borate was found to amount to 50.1%." Thus, it appears that Mucol is a mixture of common salt and borax and will do no more than a solution of salt and borax will do, yet how many of us are loath to tell our patients to go home and use a warm salt water as a mouth wash, but instead advise them to purchase Mucol or a similar preparation at the drug store?

One of the latest nostrums to shoot across the horizon is X-It. Their advertisement reads like this:

Have you tried X-It? Over 14,000 dentists and physicians are using and recommending X-It in the treatment of pyorrhea, trench mouth and other gum troubles. Dentist's reputations are staked on X-It. Success of X-It is based upon the fact that it not only has extraordinary germicidal and healing properties but is also particularly effective in stimulating the growth of new granulating tissue. Quick relief from trench mouth. Many dentists say that results justify them in calling X-It a specific for Vincent's. While we are hesitant to make this claim—yet we know it offers a treatment of outstanding value. X-It like normal saliva is alkaline and hence it counteracts any acid formation around the teeth and gums.

Why are they so hesitant to make this claim? Not because of any modesty they might possess, but because the law will not permit them to make such claims. The analysis made by the American Dental Association gave the following findings: "Liquid of dark brown color having odor of oil of wintergreen mixed with tincture of benzoin. The addition of water causes a turbidity and after some time the separation of a resin-like material. Original liquid acid to moist litmus and the diluted solution reacted likewise. This is a direct contradiction of the advertisement as the manufacturer says it is alkaline. Qualitative tests show the presence of zinc, chlorides, salicylic acid and drugs of the anthraquinone family such as senna, cascara, aloes, rhubarb and frangula. These drugs are frequently used as laxatives. The odor of benzoin together with this test suggests compound tincture of benzoin of which aloes is an ingredient. Iron, aluminum, calcium, potassium, sulphur compounds, alkaloids, formaldehyde and hydrogen peroxide were not found. Quantitative tests showed alcohol by volume, 87.5%; solids on evaporation, 2.5%; chloroform extract, 1.5%; ethyl acetate extract, 0.3%; zinc, 0.25%; chloride, 0.25%; salicylic acid, 0.05%."

"From this, it is seen that X-It is essentially a compound tincture of benzoin with a little zinc chlorid added and flavored with oil of wintergreen. Their claim is that the product is purely vegetable, yet the analysis shows the presence of a mineral astringent." Compound tincture of benzoin is one of the oldest medicaments for Vincent's that we have, but someone saw the opportunity to capitalize the idea, and now 14,000 dentists are using it and recommending it and dentists stake their reputation on it. The only saving grace it has is the little rubber cup which accompanies the bottle and is to be used as a massage cup. We all agree on the value of massage, so we will let the cup remain untilted.

Another new product is Vince. No doubt, it has some definite value, but the advertisement would lead you to believe that it was impossible to get this self-

same therapeutic value except from Vince. The fable reads thus:

> Vince, the scientific mouth wash is directly indicated in treatment of pyorrhea, trench mouth, Vincent's Angina, Vincent's Stomatitis and Gingivitis. Vince offers the following advantages over other oxygen forming agents. Alkaline in reaction, non-caustic, non-toxic, gives off nascent oxygen, fresh solutions as required. All of these advantages may be gained at the cost of only $1.00 per pound.

Yet this is simply an enumeration of the properties of sodium perborate of which Vince is principally made. The only advantage that this compound has to offer is that the taste of the sodium perborate has been masked and this you can have done by your druggist much more cheaply than at $1.00 per pound.

Another new compound, which would be of no value to the color blind dentist, is Semafor. This has been called the wig-wag system. The story of this compound is told as follows: "Semafor mouth wash is a scientifically compounded alkaline liquid originated and developed by Dr. Alfred H. Kropff, B.S., M.A., Ph.D., a chemist of rare skill and recognized authority on purifiers. Semafor signals safety and danger by color changes in the mouth." THE JOURNAL makes the following statements in regard to Semafor: "Nowhere in the letters patent does the name of Dr. Kropff appear and the patent was issued long before other facts and figures in regard to the compound would indicate. According to the manufacturers, it is recommended for soft and bleeding gums; it inhibits germ growth and acidity, checks fermentation of food particles, hardens and restores color of the gums; will destroy the odors which arise from decayed or bad teeth; polishes and whitens the teeth; is indicated in cases of systemic acidosis, particularly during pregnancy and in various mouth conditions such as gingivitis, Vincent's infection, stomatitis, etc.; also is a soothing and effective nasal spray."

The Chemist of the American Dental Association found that it was a clear, red liquid possessing an odor of aromatic oils and a saline taste. The p_H was 9.7. On addition of acid, it was decolorized; which indicates the presence of an indicator such as phenolphthalein. Qualitative tests showed the presence of chlorids, sulphates, carbonate, sodium, phenolphthalein and alcohol. Phosphates, borates, oxalates, salicylates, glycerin and other metals were not found. Calculating from the quantitative tests, each hundred cubic centimeters of Semafor would contain sodium chlorid, 5.71 gm.; sodium carbonate, 0.16 gm.; sodium bicarbonate, 0.08 gm.; sodium sulphate, 0.04 gm., phenolphthalein, 0.01 gm.; alcohol, 20.79 c.c. Therefore, a bottle of Semafor could be made by dissolving sodium chlorid, 20 gm.; sodium carbonate, 0.7 gm.; sodium bicarbonate, 0.4 gm., and sodium sulphate, 0.3 gm., in 75 c.c. of 95 per cent alcohol and adding water to make 350 c.c., then adding phenolphthalein 0.03 gm. to give it the red color. The claim is made that Semafor is an economical mouth wash. Each bottle contains 344 c.c. The prescribed dosage is 17 c.c., thus there are 20 doses to a bottle. Each dose would cost 5 cents and, when it is used twice daily as it is recommended, there would be a cost of 10 cents per day for a mouth wash; scarcely economical considering the results that could be expected from a mixture of salt, sal soda, baking soda, Glauber's salts, alcohol and the inert phenolphthalein. There is nothing basically sound about the therapeutics of the preparation.

An old standard preparation that has more or less recently taken up the standard of the dental profession and is assisting us to fight our battles is Ab-

sorbine Jr. The company publishes a small booklet called timely suggestions. Absorbine Jr. is recommended for sore muscles, muscular aches, muscular stiff neck, discomfort from simple coryza (head colds); after shaving; as a mouth wash, a gargle for throat irritations due to cold, dampness, dust exposure, excessive use of the voice and of tobacco; for sunburn, superficial cuts, sprains and wrenches, insect bites, ivy poisoning, toothache, foot irritations and tired feet; for the bath and minor burns and scalds. They also make the statement that for nearly a quarter of a century Absorbine Jr. has proved itself a valuable aid in dental surgery.

Now let us delve into the history of Absorbine Jr., and we shall see the best example of evolution ever shown, the evolution of a label, as was brought out by investigation by *The Journal of the American Medical Association.* The first label reads that Absorbine Jr. removes any soft bunch without blistering and inconvenience. Also this label reads that Absorbine Jr. cures goiter, rupture, orchitis and tumors. Then this statement was made: "Absorbine Jr., the only remedy known that positively cures varicose veins." It was also said to be indicated for abscesses, carbuncles, boils, rheumatism, neuralgia, headache, torn ligaments and sprains. The next label reads less like the typical patent remedy advertisement, since it is not claimed that it will cure any disease, although the remedy is recommended for goiter, swollen glands, tumors, wens, cysts, orchitis, varicose veins, varicocele, hydrocele, hernia, callouses, corns, bunions, carbuncles, abscesses, boils, cuts, sores, ulcers, strains, rheumatism, lumbago, gout, stiff neck, headache and toothache.

Here, for the first time, the dentist enters the picture, and since the investigation was made in 1913 and this is the second label, it hardly seems that Absorbine Jr. has been a valuable aid to dental surgery for a quarter of a century. The third label does not claim that Absorbine Jr. will remove any of the disturbances that it was claimed to be capable of removing in the first and second labels. Instead, it is listed as an analgesic, a prophylactic, a stimulant and a resolvent. The label further reads that it is to be prescribed in cases of inflammation, swelling, callouses, corns and bunions, and to allay pain and heal cuts, sores, ulcers, boils, abscesses, pyorrhea and sinuses. This is the first time that pyorrhea enters the advertising.

To further investigate, the American Medical Association examined a sample of Absorbine Jr. purchased on the open market. The result of the analysis showed that a product almost identical with Absorbine Jr. could be made from the following formula: oil of wormwood, 1 dram; oil of sassafras, 16 minims; menthol, 15 grains, acetone sufficient to make 11 drams. Needless to say, this formula is not one that could be expected to do all the wonderful things claimed for it. It probably does have some action as a counterirritant, but it is not a wonderworker.

Yet another product which has been recommended to the dental profession to prevent and alleviate pyorrhea is Ora-Noid. Theirs is a most fanciful picture. It is claimed that Ora-Noid is a composition of the essential ingredients of saliva. In other places, it is said to be a synthetic saliva containing all of the various salts, phosphates and alkaline carbonates contained in normal human saliva properly proportioned. Another statement is that there is nothing in Ora-Noid powder, with the exception of a few essential oils, that is not found in

the constituents of normal healthy saliva. Other than these enlightening remarks, nothing is said concerning the composition of this powder. Their label states that Ora-Noid is "nature's own defense," and also that Ora-Noid restores the normal chemical activity of saliva. To quote from the Chemist of the American Dental Association, the following facts were found in the analysis of two samples purchased on the open market:

> The contents were a fine white powder possessing a salty taste and an odor resembling oil of cloves and cinnamon. A small amount of gritty material appeared to be present. The powder was not completely soluble in either hot or cold water, although the impression is given that Ora-Noid will dissolve in saliva. An aqueous infusion of Ora-Noid reacted strongly alkaline. This is in contrast to normal saliva, which is reported to have a slightly acid reaction. Qualitative tests indicated the presence of calcium, magnesium, sodium, potassium, carbonate, chlorid, borate and starch. Sulphates, perborates, peroxids, nitrates, iodids, tartrates and heavy metals were not found. Phosphate in more than traces was not found, although the claim is made that Ora-Noid "includes all the various salts — phosphates and alkaline carbonates contained in normal human saliva. . . ." As saliva is known to contain normally the starch digesting enzyme ptyalin, it was of interest to carry out a series of tests to determine whether or not Ora-Noid was capable of digesting starch. Ora-Noid did not digest starch solution in half an hour; a few drops of saliva under identical conditions digested starch in less than five minutes.

In the chemical analysis, 0.4 per cent of acid-insoluble material was found which is explained as follows by the chemist: "The presence of the acid-insoluble material which had the characteristics of yellow grains of sand would indicate that materials of a lower grade than chemically pure were used."

After making a chemical analysis, the following conclusion is drawn by the Chemist: "From the foregoing, it may be concluded that Ora-Noid (powder and mouth wash in one) consists essentially of a mixture of table salt, baking soda, chalk, magnesia, borax and starch, flavored with essential oils."

It is indeed a sad state of affairs when it becomes necessary for the dental profession to rely on such patent medicines to cure dental ills.

These are only a few of the preparations that are advertised, and they were selected because of the information available in regard to them, but it is a sorry indictment to return against the dental profession. It may be concluded from the foregoing that the rationale or reasons for the use of the drugs in modern dental materia medica depends on the advertisement as printed in our periodicals, or the word picture of the specialty man; an unstable basis. When it becomes necessary to use and prescribe patent medicines, it is time for us to call a halt and turn the searching eyes of the analyst upon ourselves.

Let us keep in mind the fact that our patients are the ones who eventually must suffer from our negligence, ignorance or carelessness; and furthermore all of this can and should be avoided if we but exercise the knowledge we have or the right we have to gain more knowledge. There are two therapeutic agents which can be heartily recommended for the treatment of any case that you have or may have in your office: "fluid extract of good judgment and tincture of common sense."

EVALUATION OF THE FOREGOING PRESENTATIONS*

By NEWTON G. THOMAS, A.B., A.M., Ph.D., D.D.S., Chicago, Ill.

THE best person to give a summary of a paper is the one who wrote it. It has always been a thesis of mine that discussions of deserving papers are unnecessary addenda to a program. The committee responsible for this program have taken a step toward the exclusion of discussions and the summary indicated for me is the evidence. Obviously, this last bow to such tailings to otherwise hearable and instructive papers will be of a short duration. A man believed to be an authority in a subject can make his contentions clear enough to be understood. He can make his theme effective and convincing without extra aid. He can be happy without the flattery that usually goes with the first paragraph or the misunderstanding that usually fills the rest. An authority deserves audience and appreciation, but he does not deserve the confusion of his statements that so commonly results from discussion. I am tempted to congratulate the committee and to encourage them. Their work will be complete when the summary disappears as well.

At the outset, let me say I know what the word summary means. I know exactly what the task assigned implies, but I made the mistake of not asking the committeeman who approached me if to summarize the papers categorically was what he meant that I should do. Should I in sequence name the high spots of the four papers read and stop, or am I expected to do more and put myself under the curse of the discusser? The first would be very short and unnecessary; the second would be marked as my inconsistence. Let me, then, mention the didactics of these papers and add perhaps a comment or two that they prompt. If this adds to your resentment toward summaries and discussions and you banish them totally, I shall have no regrets. I shall have sped the day I hope for.

The paper on trifacial neuralgia is characteristic. The writer of it comes with a preparation accounted for by both heredity and environment. He has lived his life through in a medical-surgical-dental atmosphere. He emphasized the need of accurate diagnosis, a basic element in all procedure. He gave us the theory and practice of treatment of this vicious affliction. In addition to his paper, I read three surgeries on this same subject, none of which gives a syllable more of importance. Blair gives ten characteristics of the malady to aid diagnosis, showing his appreciation of this first step. All leave the patient in a hopeless world when the disease is in its last stage. All leave the practitioner with one final resort. It is at this point that I beg leave to make a comment. Brain surgery is not in the province of a general surgeon and brain surgeons are few. Here is a case history:

W. B., aged about 50, developed spasmodic, intense pain in the left side of his face over the area supplied by the second

*A discussion of the papers of Drs. Schultz, Gallie, Bryan and Timmons.

division of the fifth nerve. A touch of the lips, a breath of air, an attempt to speak brought on a paroxysm that prostrated him. He went to his dentist, but his dentist had never seen anything like it, so he ordered the extraction of teeth on the side carrying a bridge. When the teeth were extracted, the young lady at the chair exclaimed, "Oh, see the pus!" A well-trained young woman. But the neuralgia persisted. Another dentist happened to meet the sufferer, and when the patient attempted to raise his lip to show the area of lost teeth, he threw himself into another spasm of agony. This dentist, who had seen a similar case, said "You have tic douloureux." He advised the man to see a prominent surgeon, a medicodentist. The surgeon made an injection, the effects of which lasted a few days. The patient went to another, who gave him rest for six weeks. This surgeon advised semilunar resection, and said, "Get either Frazer or Cushing to do it." But the patient liked the first surgeon personally and went back to him at the end of the time suggested. Another injection was made and removal of the gasserian ganglion was advised. But now comes the point! This surgeon was loyal to the school and faculty with which he was connected: he said "Dr. ——— will do it for you." The man consented, and died on the operating table. At this moment, there are less than a half dozen surgeons in America capable of such work. It is as important as life and death that the advisor should know whom to recommend. The time is not for the dominance of loyalties and affiliations.

"Acute Oral Infection, Their Sequelae and Control," "The Rationale of Dental Therapeutics" and "The Responsibility of the Dentist for the Health of His Patients" strike a common note. I should like to place them together to some degree and comment on them in the same manner.

They are one in their demand for responsibility on the part of the dentist to diagnose, assay, know and advise or treat. Well-written, pungent, pointed, all of them. Two of them savor of textbooks and schools in their accuracy of statement and detail. The one on dental therapeutics makes its demands upon the basis of modern medicodental journalism and common sense. But they are a unit in their urge for a required intelligence on the part of the dentist and a commensurate responsibility.

One paper says: "Logically, the treatment of systemic disease falls to the field of medicine, and although the dentist plays a most important part, in the last analysis the physician must assume the responsibility for the patient's well-being and progress of the case." Again, from the same: "The true general practitioner of dentistry cannot confine his activities to operative, prosthetic and office therapeutics or surgical procedures alone. Whether you desire it or not, there are times when bedside and hospital attendance is required of you."

Another says: "We as a profession cannot avoid the responsibility that we have in recognizing the symptoms of ill-health in our patients."

One of these men writes from the atmosphere of a hospital; the other writes from that of the school. Both write with deep earnestness and a high idealism. Both tell the truth with a pointedness that is painful to many of us in general practice.

The importance of the hospital relationship to dental classes cannot be overestimated. For years, schools have found it exceedingly difficult to bridge the chasm between the science laboratories and the operative clinic. Gradually, the gap is being closed, but it was a normal sequence that that gap should remain or widen for the graduates of former days who took their sciences as extraneous if not unnecessary because, in the school infirmaries, there was no one to knit them to the practices there. And for them, too, the daily practice was a procedure of gold and silver and rubber, a little scraping and some irrigation with question-

able fluids. The intimacy of teeth and health has been a vaguely theoretical thing for thousands of such men. Diagnosis, symptomatology, systemic recognitions were and, in many cases, if not most, still are utterly beyond them. Until very recently—and in some cases the time has not come—physical diagnosis was not in any school program. Until recently, and in some schools the time has not come, dental students never saw people in bed as a result of systemic derangement from secondary infections or for any other reason. I know that you will read references to such things in speeches made by deans, but they were not practiced by the deans who made them. Some schools still vote to pass men from class to class or even to graduate them if they make good grades in operative and prosthetic laboratories even though their science grades are pitifully low.

There are two elements that militate against dental diagnosis today that are difficult to overcome. One is the practice of dentistry itself. One paper avers that "the true general practitioner of dentistry cannot confine his activities to operative dentistry" and the like, but the fact is that general practitioners do. The daily procedure of the usual dental office is a process of forgetting the basic sciences rather than of learning them. Many men, never having had a taste of scientific learning, have found it difficult to develop one because of the character of their practice. The other element of antagonism is the patient himself. The dentist might not have commanded the patient's respect of his ability to diagnose or prescribe, and so he turns to his medical advisor. Either that, or the patient utterly refuses to admit the dentist's prognosis and demands other procedure than the dentist prescribes. This happens too commonly to be ignored. Forehearing your answer to that, I quote an ex-dean who was observing a student's painstaking efforts at asepsis. He said, "You will make a good dentist, but you will starve to death." Here are two interesting occurrences: one a conception of things as they are, and the other a ground of hope for things as they should be. A teacher of years said, "I can take a boy from high school and teach him in six months to practice dentistry as it is practiced." The other is a university refusing to tolerate a dental school because it had no medical school.

The paper on dental therapeutics is an exhortation well deserving its place. This is not the first time that the "medicinal" situation in dentistry has been ridiculed. Not long since, the streamers, banners, placards, colorful cartons and artwork flasks were held up for derision in the public prints. And of course the pathos in the picture was the number of dentists who signed for samples or burdened themselves with sack loads of them to lave and irrigate and sterilize and asepticize and meet every requirement of every human ill. But who is to be criticized? The men who carted off the nostrums so pridefully or so shamefacedly? Were these men possibly reaching out blindly for something to aid them in treating what they were utterly unfitted to treat?

Let any man who took the materia medica given ten years ago in the foremost schools answer that question. Let us halve the time and ask those who took the course five years ago to give an answer. It was the kind of courses given until a very recent date that made such a fat pasture land out of dentistry for the venders of these things. Let us not forget that only a bare half dozen months have passed since the A. D. A. began

defending its constituents against the deluge of patent fluids that have threatened dental offices. As an organized body, we were late developing any seriousness about this inundation of quackery.

Again I say, the routine of general practice is inimical to a man trying to acquire expertness in these basic things. He might have recurrences of desire to lay foundations for a better knowledge, a self-confidence equal to the judgment of lesions or the writing of prescriptions, but he finds the press of his daily routine too strong for his resolve. We are expecting too much or rather we are putting our faith in the wrong place.

Pursuant to the task of this paper, I undertook to ascertain in a limited way whether prescription writing was a practice in any offices of older men with which I was familiar. One man laughed at the question as a preposterous joke. Another said, "What for?" Another replied that he had never opened a materia medica since graduation. Another informed me that the only prescription that he ever wrote he had memorized to pass the finals and the state board. Another said, "I have never had occasion to write one," and that man has had a big practice for fifteen years. Then I turned to senior students and asked three from each of four schools, and not a man said that he could write a prescription.

If you scan the catalogs of the schools, you will find that comparatively little time is given to materia medica. Drugs in dentistry as in medicine are losing their popularity and importance. A practitioner returning from Johns Hopkins, where he had gone for a little rejuvenation, said, "I left before my time was up; they put patients to bed for everything. I have to give my people medicine." What is the implication? This: Nature is the master healer. Medicine is merely to give Nature the ascendant. Removal of stress, rest, allows Nature to concentrate; hence, to bed with them. Applied to our problem, it is that medicine, drugs, are merely adjuvants to the process of healing and recovery. Prevention is the slogan of the schools. Should you visit a therapeutic procedure under Blayney, you will observe that it is a sacred rite. Care, sterilization, asepsis and Nature. Students know the seriousness of their operations. There is no make-believe, no sham about it and when those men graduate, they have faith in the technic that they have been taught.

And that is not all. The schools are gradually building up organizations of men who are capable, who are authoratative in their fields. The students believe in them. Those students know that their teachers are for the most part leaders in the world of dental thought. And that is because at last teachers are individual investigators, they have effective laboratories, they have encouragement from the universities. Their students may resort to them in any need. And those students will not be tempted to trust a heavily named nostrum, paste or salve; they will trust rather what their masters, their schools, approve, and trust themselves. The new spirit that permeates the better schools is a noticeable thing. Graduates are not taking jobs with them for the payment of office rent as used to be. Annually, young men are seeking places with the investigative departments, to give all their energy, all their time, to similar research.

One item more: One essayist said, "I believe that the profession is recognizing and assuming its rightful place because we are constantly seeing evidence of more careful diagnosis by its members." I think the man who said that is a school

man. He knows the work that is being done, the impression that is being made. I would make only one change in the assumption. It might seem draconian. The word profession implies more than I would assume. It is too comprehensive. We can't expect the results these papers have idealized over a wide area. They will come only as the new replace the old. There is a new dentistry. We are in its dawning. Each year, there is an influx of new idealism and new accomplishment and increased ability.

A decade or more ago, an eminent lecturer expressed a faith in dentistry in words that have been quoted until your ears are weary of them. I have wondered many times if he has ever despaired and wished that he had never spoken his prophecy! It seemed as though dentistry thought it had met his dream by making one-piece castings, thermolite dentures and jacket crowns. Perhaps he realized that the response would be cumulative and slow. Now, I believe, he knows that dentistry is straining at its fulfillment. Men like Bunting, Rickert, Schaeffer, Blayney, Hatton, to name only a few over a limited area, are leading the new output of youth to the fulfillment of our ideals.

LABORATORY STUDIES OF AN UNUSUAL CASE OF RESORPTION*

By EMIL MUELLER, M.S., D.D.S., and H. R. RONY, M.D., Chicago, Ill.

MRS. B. was referred to us for thorough examination because of the progressive loss of a number of her teeth as the result of cavities appearing in the root rather than in the crown. Though the crown was intact, the defects in the root eventually extended and coalesced so as to involve the whole diameter. This condition was not revealed by instrumental examination and became apparent only when the roentgen-ray films were studied. (Fig. 1.) Fortunately, other films had been taken at intervals preceding this, and from them, it was possible to obtain some knowledge of the rate of tooth destruction.

When the patient first came to us, the teeth were in the condition as shown in Figure 1. The upper right first bicuspid and most of the missing lower teeth were lost by this progressive process over a period of less than a year. The nature of this loss of tooth structures suggested that we had to deal with either caries or resorption. With a very fine huck explorer, it was possible to reach the cavities of the upper right lateral incisor and second bicuspid and the lower right cuspid. The cavities in three other teeth, the right upper central incisor and second molar and the lower right first bicuspid, were positively beyond the reach of the explorer. They were without any question under the attachment of the bottom of the crevices. These findings rather contraindicated caries, but in order to

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

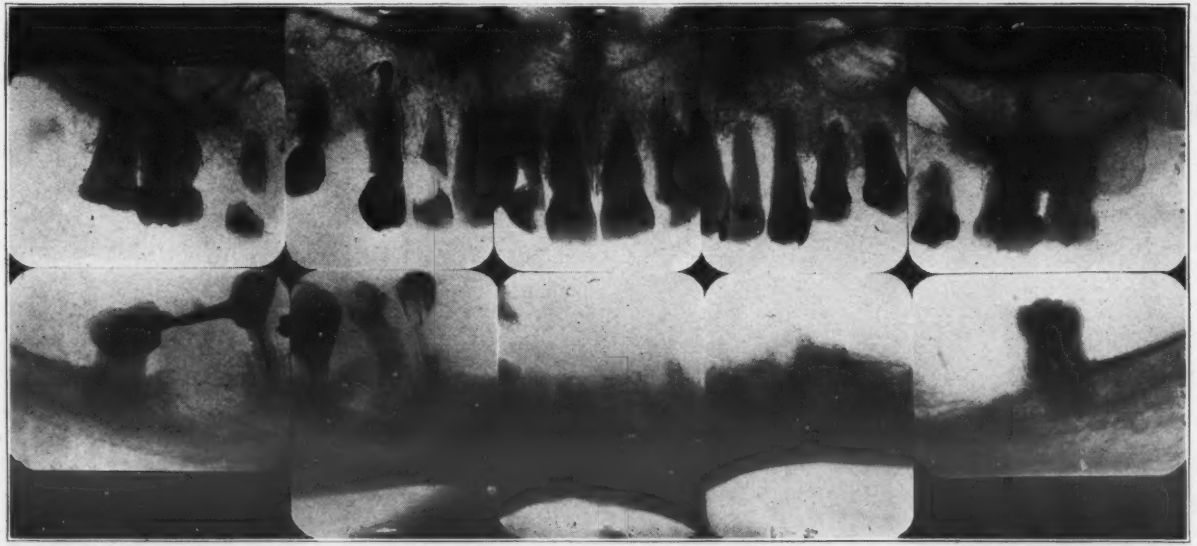

Fig. 1.—Full mouth roentgenogram taken, May 27, 1929. The upper right first bicuspid, as well as most of the lower teeth, was lost by the progressive destruction process now involving the upper right incisors, the second bicuspid and the second molar, and the lower right cuspid and second bicuspid.

Fig. 2.—Low power photomicrograph from a section of the upper right second bicuspid. This tooth was removed with the tissues intact. *a*, dentin; *b*, crevice epithelium; *c*, space formerly occupied by the enamel; *d*, osteoclastic resorption; *e*, dentinoid and fragments of unresorbed primary dentin; *f*, pulp.

rule out more definitely this possibility, cultures were made from the upper right lateral incisor. These, as expected, proved negative to *B. acidophilus*. The fact that the beginning cavities of the upper right central incisor and second molar and the lower right first bicuspid were under the attachment indicates quite conclusively that the other larger cavities also had their beginnings under the attachment. This was strongly suggestive of resorption. A histologic examination of the

upper right second bicuspid showed conclusively that the process was an osteoclastic resorption. Sections upon which this diagnosis was based are illustrated in Figures 2 and 3.

Some idea of the rapidity of this resorption process can be gained by comparing roentgen-ray pictures of different dates. The pictures in Figure 1 were taken, May 27, 1929. The films of Figure 4 were taken, Jan. 19, 1929. There is just a slight resorption noticeable on the mesial surface of the upper right second bicuspid. At this time, we wish to call to your attention the upper right lateral incisor and the lower right cuspid and first bicuspid, for less than two months later (March 6, 1929) (Fig. 5), considerable resorption has taken place on these teeth. Both the mesial and distal

Fig. 3.—High power photomicrograph of area *d* of Figure 2. *a*, osteoclasts; *b*, connective tissue; *c*, dentin.

surfaces of the upper right second bicuspid are now further involved. The lateral incisor shows a considerable resorption distally, while the lower cuspid and bicuspid are showing just the beginning of resorption. Two and a half months later, May 27, 1929, we find the teeth involved as shown in Figure 1. The teeth referred to previously are now much more extensively resorbed. By this time, it was quite apparent that if this process continued uninterrupted, the patient would very soon lose all of her teeth. Recalling the experiences of Weinmann, who found diffuse atrophy associated with physical disturbance, it was decided that if anything could be done at all for the patient, it would have to be done upon the basis of a thorough medical examination. This examination was made by one of us (H. R. R.).

Fig. 4.—Beginning resorption on the mesial aspect of the upper right second bicuspid, but resorption absent on the upper right lateral incisor and the lower right cuspid and first bicuspid. (Taken, Jan. 19, 1929.)

History.—The patient, aged 36, and married for eight years, had no children and had never been pregnant. The family history was negative for constitutional diseases. The patient had always been healthy and felt perfectly well at the time of the examination. She had no complaints except rapid resorption of the teeth. The menses were regular, of the three-day type; and the flow was scant.

Examination.—The patient was a well-built, healthy-looking young woman, of somewhat nervous, emotional behavior. The pulse was regular, with a rate of 86. Examination of the heart, lungs, and abdominal organs was negative. The thyroid gland was slightly enlarged. The knee reflexes were exaggerated, and there was marked dermographia. The nervous system was otherwise normal. A Wassermann test of the blood was negative. Examination of the urine was also negative. Blood examination revealed: 4,970,000 red blood cells; hemoglobin, 8 per cent; 6,050 white cells; lymphocytes, 41 per cent; neutrophils, 51 per cent; eosinophils, 2 per cent. Blood chemistry determinations revealed: nonprotein nitrogen, 34.10 per cent; urea nitrogen, 13.00 per cent; creatinin, 1.21 per cent; sugar, 92.00 per cent; calcium, 8.8 per cent. A roentgenogram of the sella turcica revealed no pathologic process. The basal metabolic rate was —1.6.

When the blood was taken for blood chemistry determinations, a deep brown discoloration of the serum was noticed, and an examination for bile pigment revealed that the serum gave the indirect van den Bergh reaction and that the icterus index was 9.1, which is above the normal limit. The direct van den Bergh reaction was negative. This was checked up with the same result on a blood specimen obtained several days later.

In order to get further information about the liver function, a levulose test and a sugar tolerance test were made. One hundred grams of levulose were

given by mouth on an empty stomach at 1 p. m., and the urine was examined for sugar after it was voided at hourly intervals. At 1 p. m., 95 c. c. was voided, which on test showed no glucose. The 2 o'clock specimen (74 c. c.) showed 0.2 per cent, and the 3 and 4 o'clock specimens (59 c. c. and 33 c. c.) showed only a slight trace.

A week later, 120 gm. of glucose was given on an empty stomach at 10 a. m. for a sugar tolerance test. The accompanying table shows the results:

SUGAR TOLERANCE TEST

Time	Glucose in Blood (Mg.)	Volume of Urine (C.c.)	Glucose in Urine
10:00 a.m.	92.6	64	None
11:00 a. m.	235.2	56	0.33%
12:00 m.	164.0	96	None
1:00 p.m.	100.0	160	None

Finally, according to the suggestion of Weinmann,[1] the specific dynamic effect of food rich in proteins was studied. First, the basal metabolic rate was determined in the usual way; then, the patient was given a breakfast containing 200 gm. of beef and 50 gm. of bread, and the metabolic rate was determined again one hour after ingestion of this food. Two such tests were made. The first test showed a basal metabolic rate of —3, and a metabolic rate of +10 was revealed one hour after the breakfast. The increase of metabolism, that is, the specific dynamic effect of the food, was in this case +13 per cent.

Fig. 5.—Further resorption on the mesial as well as the distal surfaces of the upper right second bicuspid. The upper right lateral incisor is also extensively involved and the lower right cuspid and first bicuspid are just beginning to be resorbed. (Taken, March 6, 1929.)

1. Weinmann, J.: Stoffwechselbefunde bei der diffusen Atrophie des Alveolarknochens, Ztschr. F. Stomatol., August, 1927.

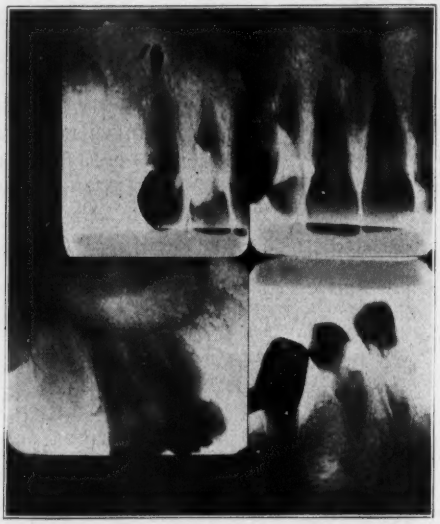

Fig. 6.—Appearance of case, July 20, 1929, two days after systemic treatment was undertaken. In this and the succeeding illustrations, observe particularly beginning resorption of the upper right central incisor and the second molar. Any change in the resorption of the teeth more extensively involved can be judged only with great difficulty.

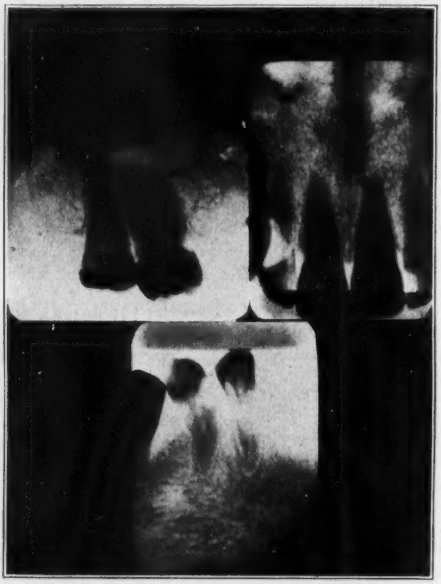

Fig. 7.—Appearance of teeth, July 31, thirteen days after the treatment was begun and eleven days after the roentgenograms shown in Figure 6 were taken.

Fig. 8.—Appearance of teeth, August 17, seventeen days after the roentgenograms shown in Figure 6 were taken and thirty days after treatment was started.

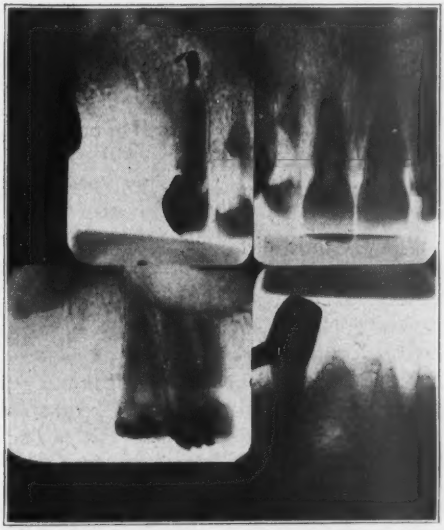

Fig. 9.—Appearance of teeth, September 5, just forty-two days after treatment was undertaken. The lower right cuspid and first bicuspid had been extracted. In comparing the upper right central incisor and the second molar with the picture of the same teeth in Figures 6-8, it is not possible to say that any further resorption has taken place.

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Fig. 4.—Beginning resorption on the mesial aspect of the upper right second bicuspid, but resorption absent on the upper right lateral incisor and the lower right cuspid and first bicuspid. (Taken, Jan. 19, 1929.)

History.—The patient, aged 36, and married for eight years, had no children and had never been pregnant. The family history was negative for constitutional diseases. The patient had always been healthy and felt perfectly well at the time of the examination. She had no complaints except rapid resorption of the teeth. The menses were regular, of the three-day type; and the flow was scant.

Examination.—The patient was a well-built, healthy-looking young woman, of somewhat nervous, emotional behavior. The pulse was regular, with a rate of 86. Examination of the heart, lungs, and abdominal organs was negative. The thyroid gland was slightly enlarged. The knee reflexes were exaggerated, and there was marked dermographia. The nervous system was otherwise normal. A Wassermann test of the blood was negative. Examination of the urine was also negative. Blood examination revealed: 4,970,000 red blood cells; hemoglobin, 8 per cent; 6,050 white cells; lymphocytes, 41 per cent; neutrophils, 51 per cent; eosinophils, 2 per cent. Blood chemistry determinations revealed: nonprotein nitrogen, 34.10 per cent; urea nitrogen, 13.00 per cent; creatinin, 1.21 per cent; sugar, 92.00 per cent; calcium, 8.8 per cent. A roentgenogram of the sella turcica revealed no pathologic process. The basal metabolic rate was —1.6.

When the blood was taken for blood chemistry determinations, a deep brown discoloration of the serum was noticed, and an examination for bile pigment revealed that the serum gave the indirect van den Bergh reaction and that the icterus index was 9.1, which is above the normal limit. The direct van den Bergh reaction was negative. This was checked up with the same result on a blood specimen obtained several days later.

In order to get further information about the liver function, a levulose test and a sugar tolerance test were made. One hundred grams of levulose were

given by mouth on an empty stomach at 1 p. m., and the urine was examined for sugar after it was voided at hourly intervals. At 1 p. m., 95 c. c. was voided, which on test showed no glucose. The 2 o'clock specimen (74 c. c.) showed 0.2 per cent, and the 3 and 4 o'clock specimens (59 c. c. and 33 c. c.) showed only a slight trace.

A week later, 120 gm. of glucose was given on an empty stomach at 10 a. m. for a sugar tolerance test. The accompanying table shows the results:

SUGAR TOLERANCE TEST

Time	Glucose in Blood (Mg.)	Volume of Urine (C.c.)	Glucose in Urine
10:00 a.m.	92.6	64	None
11:00 a. m.	235.2	56	0.33%
12:00 m.	164.0	96	None
1:00 p.m.	100.0	160	None

Finally, according to the suggestion of Weinmann,[1] the specific dynamic effect of food rich in proteins was studied. First, the basal metabolic rate was determined in the usual way; then, the patient was given a breakfast containing 200 gm. of beef and 50 gm. of bread, and the metabolic rate was determined again one hour after ingestion of this food. Two such tests were made. The first test showed a basal metabolic rate of —3, and a metabolic rate of +10 was revealed one hour after the breakfast. The increase of metabolism, that is, the specific dynamic effect of the food, was in this case +13 per cent.

Fig. 5.—Further resorption on the mesial as well as the distal surfaces of the upper right second bicuspid. The upper right lateral incisor is also extensively involved and the lower right cuspid and first bicuspid are just beginning to be resorbed. (Taken, March 6, 1929.)

1. Weinmann, J.: Stoffwechselbefunde bei der diffusen Atrophie des Alveolarknochens, Ztschr. F. Stomatol., August, 1927.

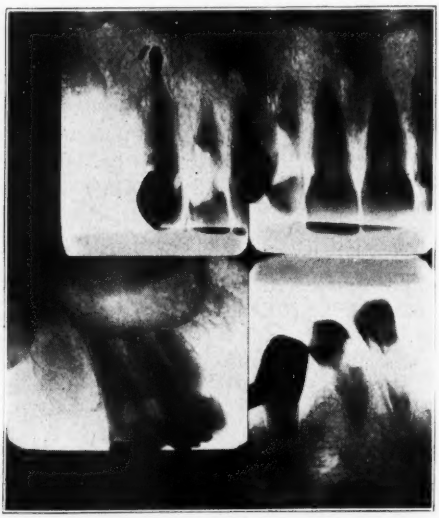

Fig. 6.—Appearance of case, July 20, 1929, two days after systemic treatment was undertaken. In this and the succeeding illustrations, observe particularly beginning resorption of the upper right central incisor and the second molar. Any change in the resorption of the teeth more extensively involved can be judged only with great difficulty.

Fig. 7.—Appearance of teeth, July 31, thirteen days after the treatment was begun and eleven days after the roentgenograms shown in Figure 6 were taken.

Fig. 8.—Appearance of teeth, August 17, seventeen days after the roentgenograms shown in Figure 6 were taken and thirty days after treatment was started.

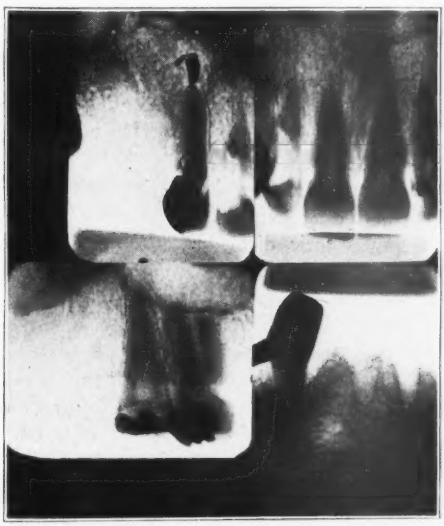

Fig. 9.—Appearance of teeth, September 5, just forty-two days after treatment was undertaken. The lower right cuspid and first bicuspid had been extracted. In comparing the upper right central incisor and the second molar with the picture of the same teeth in Figures 6-8, it is not possible to say that any further resorption has taken place.

A week later, this test was repeated, with the following result: basal metabolic rate, +5; one hour after protein breakfast, +13. The increase in this case was +8. We believe that both these specific dynamic effects fall within the normal values and therefore hesitate to ascribe any significance to them.

Unfortunately, we were not able to make further hepatic function tests because of the unwillingness of the patient to undergo further examination. We believe that the positive indirect van den Bergh reaction in the serum, together with a high icterus index and a positive levulose and glucose tolerance reaction, are sufficient to suggest strongly the presence of a functional disturbance of the liver.

The final diagnosis based upon the foregoing examination was: general neurasthenia, vasomotor instability and hepatic functional disturbance of unknown origin. This examination extended over a period of two weeks, Aug. 1-16, 1929. Systemic treatment was undertaken, August 18 and continued for six weeks. Roentgenograms of the teeth were taken at frequent intervals in order that changes occurring during the time of treatment might be observed. The systemic treatment, a low protein, low caloric diet consisting chiefly of milk, vegetables and fruits, was prescribed. Simultaneously, a heteroprotein therapy was applied, consisting of purified sterile casein intermuscular injections, given twice weekly. These injections were very well tolerated by the patient and were not accompanied by any local or general reaction. After six weeks, the patient lost 8 pounds. She continued to feel very well. Another blood examination after the six weeks' treatment revealed a negative direct and indirect van den Bergh reaction and an icterus index of 7. The levulose test was still positive as the first two specimens of urine voided at one and two hours after injection of the levulose showed a slight trace of sugar. The glucose tolerance test was negative. These changes, in our opinion, probably indicated that liver function improved during the treatment. Likewise, the teeth showed little if any further resorption during the time of treatment, as evidenced by Figures 6-9.

Whether the dental condition and the hepatic disorder are related etiologically remains, of course, to be proved. Such proof can be established only after these two conditions have been found associated in a series of cases. In one case, the association may be merely coincidental. Because of the rarity of this condition, we suggest that those finding any similar resorption consider the probability of a hepatic disorder.

We are fully conscious of the futility of attempting to draw conclusions upon the basis of our experience with one case. But because of the infrequency of these cases, we consider it equally futile to wait for other cases in order to accumulate further data. We feel justified in offering our experience and data only because we hope that we may be helpful to others encountering identical or similar cases.

The patient was referred to us through Drs. Lange, Potts and Black. We have not been able to find any record in the literature of another case like this one. Drs. Black, Potts and Gilmer have seen nothing like this case in their many years of experience in extensive practices.

NUTRITIONAL PROCEDURE FOR ARRESTING CARIES: REPORT OF CASES*

By SHERMAN L. DAVIS, Indianapolis, Ind.

CASE 1 (Reported by J. B. Carr).—The patient, a boy, aged 15, was first seen, May 12, 1928. At this time, the occlusal grooves of the first and second molars, both upper and lower, were filled, and there was also a filling on the buccogingival surface of the lower left first molar. Deterioration of the enamel on several of the teeth was noted.

The second appointment was made, September 25, when the lower left second molar on the buccogingival surface was filled. Deterioration of the enamel on the upper cuspids and right molars and also on the lower cuspids and bicuspids was noted. The enamel was entirely broken down on the cuspids. The worst of this was polished off. The lower left cuspid had developed a cavity. The upper central and lateral incisors, at this time, showed a slight paling of the enamel on the gingival. Treatment as follows was started at this time:

1. One compound calcium tablet before breakfast and supper.

2. One teaspoonful of silver lactate after breakfast and supper.

3. Diet:

(*a*) Whole wheat bread.

(*b*) Whole wheat or bran cereal.

(*c*) The juice of two oranges daily; other raw fruits in season.

(*d*) No candy.

(*e*) Very little pastry.

(*f*) About 5 ounces of meat a day.

(*g*) Potato once daily.

(*h*) From a pint to a quart of milk daily.

(*i*) A liberal helping of a raw vegetable salad at least once daily.

(One may select any vegetable or combination of vegetables that is palatable. The best vegetables in nutritional value are carrots, spinach, tomatoes and celery.)

December 31, third appointment, the patient reported that he had followed Dr. Davis's treatment to the letter. A small bucco-occlusal cavity in the lower second molar was filled. All traces of deterioration of enamel on the upper central and lateral incisors had disappeared and the enamel was apparently of normal color. The dentin was almost as hard as the enamel on the other affected teeth. The labiogingival surfaces of all four cuspids could be polished smooth, and the dentin was almost as hard as enamel, including the lower left molar in which the cavity existed. These teeth took a high polish and were left, I believe, in a perfectly safe state. No further breaking down of the enamel had taken place on the other teeth.

CASE 2 (Reported by Ert J. Rogers).—A young man, aged 21, came in June 14, 1928. Exploration revealed numerous cavities, mostly of the smooth surface type. Some were open cavities which allowed self-irrigation; others had openings through the enamel of such small caliber as to make self-cleansing impossible. On the anterior teeth, the cavities were both proximal and cervical. The lower right lateral and central incisors had at least half of the enamel destroyed on the labial surfaces, but the lingual surfaces were intact.

Excavation of the numerous cavities was difficult because the dentin beneath the carious material was white and very soft. The patient was given orange juice, compound calcium tablets and actol.

August 10, he went to military camp, where he remained until September, the treatment being continued during this time.

September 10, examination showed that the dentin was harder, approximating normal, though still light in color.

*Read before the Research Session at the Sixth Annual Meeting of the American Association of Dental Schools, Chicago, Ill., March 26, 1929.

September 22, exploration showed that the dentin was normal in hardness and color, and it gave a normal response to the usual tests. The patient showed marked improvement orally and in general physical well-being. The nutritional treatment made extraction of all teeth unnecessary.

A CASE OF TRIGEMINAL NEURALGIA

By T. I. LERCHE, D.D.S., Chicago, Ill.

A MAN, aged 58, complained of paroxysmal pains in the region of the right upper lateral tooth, the area extending toward the eye and to the head. The pain was so severe that it interfered considerably with his work. The pain would cease as suddenly as it had started. It had become more intense for some time past, and recurred from eight to ten times daily.

About twenty years previously, the patient had an infection in the area mentioned and was incapacitated from work for nearly three months. About fourteen years previously, the tooth was extracted, but no attention was paid to the infected area beyond it and no roentgen-ray record was made. Four years previously, the pain of which he now complained started. The paroxysm started on touching the gum or the lip, or when shaving, in this so-called trigger zone of trifacial neuralgia.

A diagnosis of trifacial neuralgia was made. A roentgenogram disclosed a radiolucent area near the root end. When the area was opened, a granuloma was found in which were a number of fibers, looking like fine straight hairs or wires, running toward the ridge of the alveolus, and apparently ending in the mucous membrane, where the trigger zone was located. The granuloma and infected bone were removed. The patient has not complained of the pain to date, (after four months).

In a rather limited search of reports on this matter, only one was found, a case of trifacial neuralgia successfully treated by removing an old dento-alveolar infection.

The Journal of the American Dental Association

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C. N. JOHNSON, Editor

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Editorials

THE NEW COUNCIL ON DENTAL THERAPEUTICS

The Board of Trustees of the American Dental Association has organized a council to direct the activities connected with the investigation of the various therapeutic products that are being offered the profession and the public.

The Council consists of the following: Paul J. Hanzlik, M.D., professor of pharmacology, Stanford University School of Medicine; Percy R. Howe, D.D.S., professor of dental science, Harvard University, and director, Forsyth Dental Infirmary for Children, Boston; Milan A. Logan, Ph.D., instructor, department of biologic chemistry, Harvard University Medical School; Arno B. Luckhardt, M.D., professor of physiology, University of Chicago; John A. Marshall, D.D.S., associate professor of dental pathology and biochemistry, University of California College of Dentistry; Victor C. Myers, Ph.D., professor of biochemistry, Western Reserve University; John P. Norton, Ph.D., chief of laboratories, department of health, Detroit, former professor of

bacteriology and hygiene, University of Chicago; Ura G. Rickert, D.D.S., professor of physiologic chemistry, hygiene and therapeutics, University of Michigan School of Dentistry, and Harold S. Smith, D.D.S., practicing dentist, Chicago.

Ex-officio members of the council are: C. N. Johnson, D.D.S., editor of THE JOURNAL; Harry B. Pinney, D.D.S., Secretary of the American Dental Association, and Samuel M. Gordon, Ph.D., American Dental Association Chemist and former National Research Council Fellow in the biologic sciences. Dr. Gordon has been appointed secretary of the council.

This council convened at the American Medical Association Building, Chicago, Jan. 3 and 4, 1930, and organized. In effecting this organization, our Association is under a deep debt of gratitude to Paul Nicholas Leech, director of the chemical laboratory of the American Medical Association, for his invaluable aid in pointing out the necessary procedures and directing the members of the council in their early activities. It is also pertinent to state once more how much our Association appreciates the courtesy of the A. M. A. in furnishing laboratory facilities for our chemist ever since the work began nearly two years ago.

The analogous body in the American Medical Association is called the Council on Pharmacy and Chemistry, and this council has rules to govern its activities which, in large part, formed the basis of the rules adopted by our Council on Dental Therapeutics.

Until these rules are crystallized and systematized, and finally passed on by the Board of Trustees of the A. D. A., it is premature to publish them, but it may be said that the scope of the Council will be to advise the dental profession and the public concerning dental proprietary remedies and materials as regards composition and therapeutic usefulness. Its endeavors will be directed toward the goal of protecting the dental profession and the public against fraud, undesirable secrecy and objectionable advertising in the marketing of proprietary dental remedies.

It will now be made clear that any published statements concerning the virtues or otherwise of a product will emanate from

the Council, and the entire body will be responsible. It will at once give greater force to these reports when it is known that they have back of them the consensus of opinion of so many eminent men. No article making false or misleading claims will be permitted in the advertising pages of THE JOURNAL, and when this becomes known, strength will accrue to the advertising policy of this publication, and this will result in increased respect for those products that are permitted to appear.

All in all, we look forward to the work of the Council on Dental Therapeutics with the utmost anticipation of benefit. It is precisely the sort of organization that has been greatly needed in the protection of the profession, and, through the profession, the protection of the public against imposition on the part of the unscrupulous manufacturers. But the fact must be made perfectly clear that it is not the intent to hamper in any way the activities of responsible manufacturers who are honestly endeavoring to supply worthy products to the profession. In fact, it may sometimes so happen that the Council will be of great aid to certain reliable firms who are conscientiously seeking to serve the profession, but are not quite clear as to what claims should or should not be made for their product. Sometimes, a slight change in the wording of an advertisement may mean the difference between its acceptance and its rejection, and with all worthy manufacturing enterprises, the Council will be found heartily cooperative.

The result of the work in the department of dental therapeutics promises much concrete benefit to the public, and our Association may be congratulated on having made one more forward step in its service to humanity.

TWO POINTS OF VIEW

It would be a queer world if every one believed alike. A difference in the point of view lends spice to our lives and contributes to a never-failing interest in the affairs of men. But it is true that at times the divergence of opinions is so great as to be almost bewildering. An instance of this may be found in the dif-

ferent reactions of two men to an editorial, "Equity Among Dentists" in the December number. One man wrote as follows:

After reading your two editorials, "Equity Among Dentists" and "Move Over" in the current issue of the American Dental Association magazine, I feel that I would be remiss in my duty if I did not write you a note of appreciation. I am sure I have never read anything more impressive, more sincere, more helpful and more truthful. I wish that those editorials could be issued in pamphlet form and placed in the hands of every man engaged in the practice of dentistry and if each one would follow your advice what a wonderful profession we would belong to.

Frankly, such an expression as that consecrates an editor to a determination to do better and more conscientious work, not only in his editorial capacity but also in every line of his endeavor. It sanctifies him to his service as nothing in the way of financial reward can ever do.

But here is another point of view, and in order to be perfectly accurate, we take the liberty of reproducing the letter precisely as it was received, without presuming to exercise the editorial prerogative of changing a word—omitting only, in the name of sweet charity, the identity of the author.

Editor of *The Journal,*

Kind Sir:

You are not talking to the members of The American Dental Association in that article, "Equity Among Dentists."

Some one has just been itching to fill a few pages of your Journal. He has taken about four pages of the valuable journal and addressed it to the quack dentist, and I am sure we do not appreciate it for we all consider ourselves real dentists. If you could get this article into the hands of a few quacks it might do some good, but not in the journal as it is. It is really an insult to the profession. You can razz us enough without going out of your bounds and razzing us about something of which none of us are guilty.

Possibly you have been guilty of these things which you enumerate, is the reason why you infer that all dentists do it. And about the Exodontist,—The Physician sends patients to the dentist and points out the teeth that should be extracted, and you think it is alright. Yet a trained Exodontist gets the devil when he tries to safeguard the patient's health by pointing out the teeth that should come out. Isn't he capable of doing this? And the one reason you upbraided the Exodontist for so doing was that the poor Damn Fool woman was too nervous to stand the strain of the bad news. I wonder what the poor thing would do if her husband were to fall down an elevator accidentally, I suppose they would just tell her in a gentle voice that he had decided to go to Heaven, and she could meet him there.

We like good stuff in a journal, but the unnecessary we do not. And I consider this unnecessary, at least you have been talking to a bunch of quacks and not the members of the American Dental Association.

Respectfully.

To which "soft impeachment," the reply was as follows:

My dear Doctor:

Your letter of Dec. 6th has come to my desk because I was the one who wrote the editorial to which you object. For lack of time I cannot take up the various observations you make, and must content myself by referring to only a few.

If you will permit me I should like good-naturedly to correct you on several counts. I didn't "itch" to fill a few pages of THE JOURNAL. I sometimes ache, but I don't itch. I wasn't "razzing" you or anyone else. I was merely stating a fact which actually happened. And it happened not to a quack but to a member of the American Dental Association. This I regret more than you possibly can, because I have worked with our members longer than you have and I love them more than you. You say that I "think it is alright" for a physician to point to a tooth and order it out. You are mistaken; I do not. On this point I have had many a controversy, and I have never admitted that a physician had the right to do that without consultation with a dentist.

If, as you intimate, you were insulted by the editorial, I am sorry, because I have neither the time nor the disposition to even attempt to explain away or to make amends for the character of "insult" contained in that editorial.

But the thing of all others about which I should like to correct you was the fact that the lady referred to was not a "poor damn fool woman" as you say. She was a lady. I am sure that she never could have been induced to write the kind of letter you have written.

The only reason that you are getting an answer is because I have made it a rule of my life never to fail to acknowledge a letter.

In conclusion, my dear Doctor, I have a suggestion. The first time you have an opportunity please call at the editorial office and let us sit down together and talk matters over. Maybe we shall understand each other better, and if I cannot prove on the evidence at hand and with all good feeling that you are what you called that woman, I am perfectly willing to apologize.

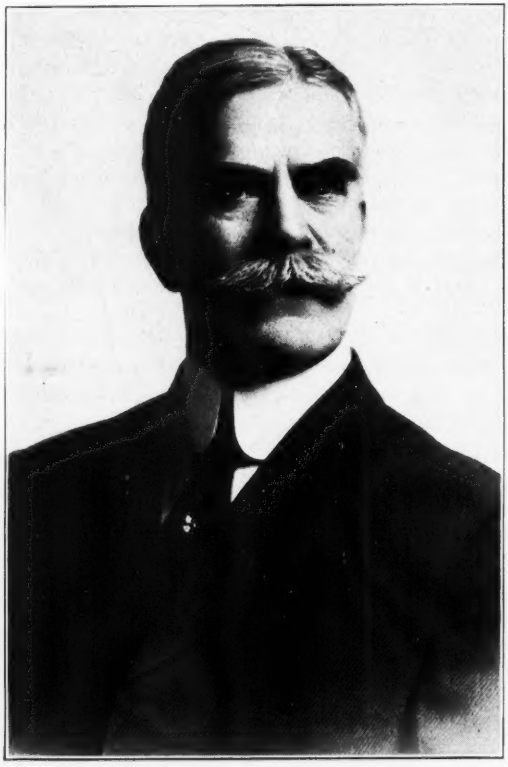
Yours in faith, hope and charity.

C. N. JOHNSON, *Editor.*

JOHN DEANS PATTERSON, D.D.S., F.A.C.D.

1848-1930

John Deans Patterson was born, Feb. 9, 1848, in Ashland County, Ohio, and died, Jan. 12, 1930, at Kansas City, Mo. He received his early education in the public schools and later in the Savannah Academy. He commenced the study of dentistry in the office of Dr. Newton, in Savannah, Ohio, where he studied one year.



JOHN DEANS PATTERSON, D.D.S., F.A.C.D.
1848-1930

He then went into the office of Moses De Camp of Mansfield, Ohio, where he spent two years.

He practiced for a short time in Savannah and, in 1868, moved to Lawrence, Kan., where he practiced until 1884. He then moved to Kansas City. He was one of the organizers of the Kansas City Dental College in 1881, and served as dean for

a number of years. The *Western Dental Journal* was organized in Kansas City with Dr. Patterson as editor, a position he occupied for twenty years or more.

During his life, he was an important factor in the development of his profession and held every position that organized dentistry had to offer.

Besides the minor offices, he served as president of both the Kansas and Missouri state dental associations and was President of the American Dental Association.

He was a man of the highest professional ideals, an excellent operator and a student of every branch of dentistry. The literature has for a half a century been enriched by his contributions on all subjects pertaining to practice. He has been for many years one of the stalwarts of the profession. He was commanding in appearance and bearing, and always stood for the highest and best in dentistry. His ideals of ethics and professional conduct were of the most exalted character, and no one was ever left in doubt as to his principles or his policies.

Frank and outspoken in his every utterance, he was at the same time always gentlemanly and dignified. He held the respect of every one and the sincere affection of many. He leaves a void in our professional ranks that will never quite be filled, because the times during which he was most active called forth men of a type which we seldom see today. He was an ornament to dentistry and a splendid citizen of the community. His record while living was an example, and his memory is a benediction.

C. N. J.

HERBERT F. HARVEY, D.D.S.

1851-1929

Herbert F. Harvey was born near Utica, N. Y., and died at Cleveland, Ohio, Dec. 25, 1929, in his seventy-ninth year. At the early age of 9, he faced the world alone, and never wavered till he reached very near the pinnacle of his profession.

He was graduated at Ann Arbor in 1879, and began practice with D. R. Jennings of Cleveland. He was of an inventive mind and designed the first leather-faced mallet and other appliances. He became a brilliant operator and made for himself an enviable position among the most successful practitioners of his state.

He helped to organize the dental school of Western Reserve University, and taught orthodontia and operative dentistry. He was a charter member of the Cleveland Dental Society, and was also prominent in the Ohio State and Northern Ohio dental societies, holding many official positions.

He was quiet in demeanor, gentlemanly in bearing and always the polished and delightful gentleman. He was a most charming companion, though never aggressive in his associations; and when he made a friend, it was to retain him for life.

About five years ago, he retired from practice with a competence, and devoted himself to traveling, hunting, art and golf. He never married, and left only a few relatives, besides his numberless friends. Dr. Harvey was one of the highest types of true professional gentlemen, and he commanded the respect not only of his associates in the profession, but also of his patients and a wide circle of acquaintances. The profession is poorer by reason of his passing, but richer because he lived.

C. N. J.

BUREAU OF CHEMISTRY

HELPING THE A. D. A. BUREAU OF CHEMISTRY TO HELP THE PUBLIC

EARLY in its work, the A. D. A. Bureau of Chemistry examined and reported to the profession on a nostrum with dangerous potentialities, sold to "whiten the teeth": Tartaroff, found to consist principally of hydrochloric acid.[1]

In the Bureau's report, attention was called to the harmful and deleterious effects to the teeth from the application of such an acid. At the same time, it was suggested that the dental profession could protect the public health by advising the public concerning the dangers of this and similar preparations.

In this connection, the following reports of serious damage following the use of Tartaroff are of interest:

A dentist writes:

> I know of two cases where mouths have been injured seriously by the use of "Tartaroff." I have read your report on this product in the November, 1928, issue of *The Journal of the American Dental Association* and therefore know what you think of it. But since it is so harmful, could not more definite steps be taken to protect the public from it?
>
> If it is possible, . . . it should be taken off the market. . . .

A physician writes:

> The enclosed copy of a report of the Bureau of Chemistry of the American Dental Association was given to me by a patient of mine, aged 23, whose dentist informed him that all his teeth will have to be removed on account of caries resulting from a few weeks' use of the preparation "Tartaroff" therein described.
>
> He is particularly anxious to protect others from a plight similar to his and has applied to me to learn the procedure required to force the manufacturers to correct false and misleading statements in their advertisements of this dangerous remedy.
>
> Will you please let me know the proper authorities before whom this matter must be placed?

It appears that this is a case for the Food, Drug and Insecticide Administration of the U. S. Department of Agriculture, or the food and drug commissioner of the respective states. But such relief as these departments can give is, after all, only regulatory. It is appreciated, most of all by unscrupulous nostrum vendors, that the statements on the labels or advertising can be changed to circumvent the law, but the original objection or harmfulness of the product is not removed. Were it not for such agencies as those mentioned, we can be sure that the health of the public, as far as nostrums are concerned, would indeed be precarious.

Where, then, lies the remedy? At the risk of being trite, an old, but nevertheless true, formula is repeated. The final cure lies in education and publicity regarding the harmfulness and worthlessness of most types of nostrums. Agencies such as the American Dental Association

1. Similar preparations are Bleachodent, Ivoglo, Taxi, Ritz Tooth Cleaner and Stain-Remover.

Bureau of Chemistry are in a position to furnish facts. It lies with the dental profession to transmit this information to the less informed public, whose oral health and welfare are in their keeping.

CORRECTION

Owing to an unfortunate circumstance in the printer's office, an error occurred in the A.D.A. Bureau of Chemistry report on Lavita (January, 1930) as follows:

"Quantitative determination yielded the following:

Loss at 100 C. "Moisture and volatile oils"	2.20 per cent
Ash	87.40 per cent
"Sulphated ash"	90.80 per cent
Pumice (acid insoluble)	84.00 per cent
Iron (Fe^{+++})[1]	0.07 per cent
Sodium (Na^{+})[2]	1.96 per cent

"From the foregoing it may be concluded that Lavita Dental Powder contains essentially[3]:

Pumice	84.20 per cent
Soap	9.80 per cent
Sodium bicarbonate[4]	1.90 per cent
Potassium (K^{+})	0.19 per cent
"Fatty acids"	8.90 per cent
"Soap"	9.80 per cent
Carbon dioxid (CO_2)	0.98 per cent

Corrected, the foregoing should read as follows:

"Quantitative determinations yielded the following:

Loss at 100 C. "Moisture and volatile oils"	2.20 per cent
Ash	87.40 per cent
"Sulphated ash"	90.80 per cent
Pumice (acid insoluble)	84.00 per cent
Iron (Fe^{+++})[1]	0.07 per cent
Sodium (Na^{+})[2]	1.96 per cent
Potassium (K^{+})	0.19 per cent
"Fatty acids"	8.90 per cent
"Soap"	9.80 per cent
Carbon dioxid (CO_2)	0.98 per cent

"From the foregoing it may be concluded that Lavita Dental Powder contains essentially[3]:

Pumice	84.00 per cent
Soap	9.80 per cent
Sodium bicarbonate	1.90 per cent."

1. The iron probably arises from the acid treatment of the pumice. It is unlikely that iron compounds were added in view of the insignificant amount found.

2. The combined amount of sodium and potassium as found is higher than that accounted for by carbon dioxid and "fatty acids." This is not surprising in the light of the analysis. "Soap" generally is not a single chemical entity but a mixture of one or more fatty acids, prepared by the saponification of animal or vegetable fats, usually with sodium or potassium hydroxid. The ultimate composition of "soap" has not the same constancy of character as sodium chlorid, sodium bicarbonate, etc. It is not improbable that part of the sodium and potassium arise from the action of acid on the pumice.

3. The composition of the tooth powder is similar to some of the scouring and washing powders on the market.

4. The sodium bicarbonate is calculated directly from the determined amount of carbon dioxid.

BUREAU OF DENTAL HEALTH EDUCATION

PREVENTIVE DENTISTRY; ITS SCOPE AND POSSIBILITIES*

By C. N. JOHNSON, L.D.S., D.D.S., Chicago, Ill.

THE scope of preventive dentistry is almost unlimited. There are so many avenues of approach in attempting to solve this problem that at times there is danger of confusion in our ranks when we try to formulate the best plan to bring it about.

We may as well recognize the fact in the beginning that prevention must come from the people. At least, they must do their part or prevention will never become an established fact. It is the function of the profession to study the best means for prevention and to direct the people in the procedures which they must follow in cooperating with the profession for the solution of this problem. And sometimes the people are slow to cooperate.

This thing is certain: neither the people nor the profession will ever bring about prevention without aid from each other. No matter how faithfully the members of our profession may labor toward the solution of this problem, they will not get very far unless the people cooperate with them, and, conversely, the people can accomplish little without direction from the profession.

There are two chief obstacles that loom large on our horizon when we approach this subject: the fact that dental decay is the most prevalent of all human diseases, which renders the task of preventing it a most colossal one, and the fact that it is not contagious. While it may do a greater aggregate harm than some of the contagious diseases, in its very nature it does not appeal to our health authorities as an appropriate malady for compulsory measures of prevention.

Smallpox has practically been stamped out because public health officials have compelled people to be vaccinated. Had it not been for the rod of the law dangling over their heads, countless numbers of people who are now living would have lost their lives from smallpox. The quarantine has done much for the protection of the people by preventing the spread of contagious diseases, and all along the line, we find the people protected in spite of themselves, and frequently in the face of the most bitter opposition on their part. The road to public health has been strewn with the wrecks of prejudice and ignorance, but, in the face of all of this, the prevention of many diseases which, in the past, have devastated the land has become an established fact.

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 8, 1929.

Our appeal to the people for cooperation in the prevention of dental disease must be along the line of reason instead of compulsion, and we do not always find the people amenable to reason, even when the appeal is solely for their benefit. There seems to be in human nature a perversity in matters of this kind, and this perversity must be reckoned with in any attempt to interest them in problems of prevention.

But we are gradually making headway, and the future is not altogether dark. Our scientific men are studying the effect of diet on the prevention of dental disease, and they give us promise that some day in the future they may work out a solution for our problem through this medium. Already they have thrown much light on the subject, though the question of diet is not a very simple one and there are so many contingencies and ramifications that the rank and file of the profession are lost in a maze of apparently confusing evidence. It is proving a very difficult matter to carry home to the people the lessons of diet in sufficient force to induce them to cooperate with their professional advisers to the extent of reaping anything like a widespread benefit. But here a little and there a little, the seed is taking root, and our people generally are following a more rational diet than they did generations ago. At least, they are putting more intelligence into their selection of food materials and are gaining a better grasp of the significance of diet than their ancestors had. So while at times it would seem that the labors of our dietitians were not bringing forth much fruit, it may be that the sum total of the effect on the future will result in greater good than we think.

Assuredly this much is true: the research work of some of our investigators is showing a definite result in what can be accomplished by an intelligent selection of diet in animal experimentation, and if these results are demonstrable in animals, there is no reason why they should not apply with equal force to human beings. Experiments amply prove that a definite damage and a definite good may be done to an animal by varying the diet, and as a result of these studies, we may hope to fix ultimately on a diet that will result only in good. Much has already been worked out along this line, and if we could only induce the people to select their diet in accordance with established findings, we could hope to accomplish something for them. In this as in other health measures, we are confronted with the notorious fact that the people cannot be induced to take advantage of the knowledge that has been gained for them. It is estimated that if our population would only live up to the health knowledge that has been proved beyond peradventure, the actual information that has been gained on health measures for the people, it would add ten years to the tenure of human life. If this is true, the toll that is exacted for our perverseness is staggering, and we pay a heavy penalty for the wilful neglect of our privileges.

One thing that militates against a uniform use of the best demonstrated diets is the fact of personal idiosyncrasy. We find that individuals have certain likes and dislikes which influence them in their selection of foods, and whether these likes are acquired or inherent, they are sometimes so strong that nothing in the way of reason or argument can overcome them. To prescribe a suitable diet for a person of this type is to run up against a stone wall unless it so chances that a suitable diet is the kind of diet he likes. With all the handicaps associated with the subject of diet, it seems questionable that preven-

tion of dental decay will be achieved through this medium in the near future, and yet we should cooperate with the dietitians to the greatest possible extent and utilize their findings as far as our patients will permit.

But there is another angle to this problem of prevention to which I should like to call particular attention at this time. Even if we are unable to control the diet of our patients as we would like, we still have recourse to a plan of prevention that is by no means negligible. It is true that in this we must also have the cooperation of the patient, at least to the extent of his appearing for dental inspection and needed care at regular intervals. If we could prevail on parents to bring their children to the dentist at stated periods from the time they are 3 years old, we could insure them that these children would reach adult life with a good set of natural teeth. And this would be an achievement worthy of our best endeavor. To get the most out of a preventive program of this kind, we must study somewhat carefully the manifestations of susceptibility and immunity in the mouths of our patients. And this is a subject that for some unaccountable reason does not seem to make much of an appeal to our profession. At least, the rank and file of dentists do not manage their cases with an intelligent recognition of the possibilities of bringing about a condition of immunity in mouths that are susceptible. That this can be done in the large majority of cases is capable of irrefutable demonstration; in fact, it has been accomplished so frequently as to become merely routine practice in the experience of a goodly number of observant practitioners. I have been so impressed with its possibilities that I have repeatedly called attention to it, and I wish at this time to emphasize its importance in the strongest possible terms. It has proved to me the most practical and tangible plan of prevention that I have been able to employ, and, through its medium, it has been my pleasure to see numerous cases in which the young people of a family have been brought up into the twenties and frequently even to adult life with a full equipment of natural teeth in good condition at an age when their parents had lost many or all of their teeth.

The means for bringing about this condition are really very simple, but they are at the same time exacting; and it is first necessary to gain a clear conception of the significance of susceptibility and immunity and be able to recognize the clinical symptoms in the mouth. The operator who merely fills a cavity in a tooth when he sees it, and lets it go at that, is not getting very far on the road to prevention, any more than will routine work of any kind produce satisfying results in all the varied activities of professional life.

The plan of procedure is to take full supervision of a mouth and watch with punctilious care for the beginnings of decay. The moment a cavity appears, it should be filled, and the earliest break in the enamel should be detected by frequent examination of the teeth. Decay should be fought as if it were contagious, and in mouths that are susceptible, the slightest imperfection in the enamel should receive attention. The dates for examination should be set by the dentist and he should insist on regularity and perseverance, at least during the period of susceptibility. Meanwhile, he should supervise the care given the teeth by the patient, and as often as is necessary, he should supplement this care by a so-called prophylactic treatment. I use the term "so-called" because, no matter how carefully the teeth may be cleaned at intervals by the

dentist (and the process is at its best only a thorough cleaning), it is not always, or necessarily, prophylactic in its results. But it does help in the general attempt to keep the teeth clean, and its results are beneficial, not only in its immediate effect on the teeth and mouth, but also in its stimulus to the daily care of the teeth by the patient. And anything that will contribute to this daily care is to be commended and encouraged. The patient should be coached in the best care of the teeth, and if there is evidence of inadequate or ill-advised use of the brush, the dentist should point out the discrepancy and see that it is remedied.

Mention has just been made of the necessity of giving attention to imperfections in the enamel, and this at once brings up the question of fissures and their treatment. During recent years, there has been in certain quarters a rather strong advocacy for the drilling out of every fissure in the tooth of a child as soon as the tooth is well through the gum, with the idea that these fissures are invariably an element of weakness and will ultimately lead to a definite decay. I have never seen any reference whatever by the advocates of this practice to the question of susceptibility or immunity as a factor in deciding whether or not a fissure shall be drilled out and filled. In very susceptible mouths, no precaution is too great to protect the teeth against the progress of decay, and, in these mouths, a fissure in a tooth must always be looked on as a menace and should be cared for. Filling, of course, under these circumstances, is the most certain method of protecting the tooth, and, in extreme cases, there is no question of its desirability.

But in very many cases, I do not consider this practice justifiable if decay has not yet begun in the fissure. In children who are immune, or who promise an early immunity, I have never yet been able to bring myself to put a drill in an otherwise sound tooth and open a fissure. I have seen too many cases in which such teeth have gone without decay for a lifetime to justify me in anticipating trouble by drilling every fissure and inserting a filling. As I have intimated, I would base my decision largely on the evidence of susceptibility in that particular mouth. When I made this statement on one occasion to an advocate of drilling, I was met by the tart remark: "This might be a logical position to take if it were possible to tell whether or not a mouth is susceptible."

To this, I made no reply, but I was sorely tempted to say that if a practitioner after a few years' experience and with any study of such conditions could not tell that a given mouth was susceptible, he would better quit dentistry and take up some other pursuit. The evidences of susceptibility are so plainly apparent that "he who runs may read," and no one in the practice of dentistry should rest content without a clear understanding of this entire question of susceptibility and immunity as it affects our daily work. It will give him a more intelligent basis on which to conduct his practice than will any other single item of information, and no man can practice successfully without this knowledge.

A campaign of care on the part of the patient and the dentist such as I have just outlined will usually prove of the greatest value in bringing about prevention in the mouths of most children, and, in my experience, it has proved the most satisfying of all my efforts. To see the young people in your practice growing up with splendid teeth, to see family after family of these young people without a pulpless tooth in their mouths, and to see them approach adult life with a full and effi-

cient equipment of natural teeth, with gums healthy and the supporting structures of the teeth firm and normal, is the acme of successful practice, and it is the goal toward which we should all aspire. As has been intimated, it requires cooperation on the part of the patient, and our efforts should be directed toward the education of the people along these lines.

Not till this knowledge of the necessity of early care is made a household word in the land shall we be absolved of our duty in the matter of public education, and this is no easy task. It requires devotion to duty of the highest order, but the end of our efforts, if kept up sufficiently long and sufficiently active, will see a generation some day of people who will have little tendency to decay of the teeth, and what little tendency they have will be so easily brought under control that the function of our profession will change from one of constantly repairing the damage done by disease to that of anticipating disease and checking it before it has become serious. In other words, prevention will be the watchword in fact as well as in theory, and dentistry shall be known as a profession with a vision, a vision of real prophylaxis, which shall redound to the credit of our calling, as well as to the concrete betterment of the race. When the time comes that we shall be able to prevent or control the vast amount of dental disease that we see today, there will result to the people of the world such a definite benefit that humanity will be made more efficient for its destined service in our coming civilization.

I wish it were my privilege to convey to the profession my conception of the possibilities that lie just ahead of us in a better service to the people. When I think what dentistry has accomplished even in my short lifetime, it gives me the courage to predict that the future has in store for us a development that few of us can realize. It should be the ambition of each one of us to do his full share in contributing to this development by the most earnest effort and the highest consecration to professional duty. If every one, or even only those of our Association, did his utmost toward the desired end, it would not be long before the ultimate goal would be reached. And if, and when, this goal is reached, it will be found that the most significant factor in the achievement will be the very one which we are considering today—prevention.

DENTAL HEALTH ACTIVITIES IN OTHER FIELDS OF HEALTH EDUCATION*

By GUY S. MILLBERRY, D.D.S., San Francisco, Calif.

IS there any single health problem more widely discussed or more frequently mentioned in the press than that associated with dentistry? Granted there is none, this fact must be attributed to public interest because, in point of numbers, the ratio of dentists to the population of the United States, 1 to 1,850, does not justify the assumption that professional concern and influence is responsible for this activity. Health matters of every

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kind are discussed every day by most of the people.

Surely this widespread interest in dentistry is not due solely to the activities of the American Dental Association or its component state and district societies, because their publicity is carried on chiefly through professional journals and bulletins, rarely if ever read by laymen. The dentist's associational interest in this question can be easily demonstrated by comparing the attendance at the meetings of this section with the attendance at the convention as a whole.

Except for the information conveyed by word of mouth from the dentist to the patient at the chair, little dental health activity is manifested by the dental profession. It may be that this constitutes the leaven in the mass of humanity, a great many of whom are beginning to think seriously about the care of the teeth.

What part of this public interest is due to the advertising put forth by the manufacturers or sales organizations dealing with toothbrushes, tooth pastes or other trade articles or preparations? The aggregate of the sums expended for this form of education is estimated at $20,000,000.00, annually, and this does not include the expenditures for window displays or mail order catalogs. How do these dental health activities affect the problem of conserving human teeth, the task we are all striving to accomplish, and how do they affect the profession?

Is the national interest in dental health due to casual articles on the care of the teeth which are published in the health columns of the daily press, the journals devoted to health or even in the popular weekly or monthly periodicals? To test your memory: How much do you remember of the last article on dentistry that you read in the *Atlantic Monthly* or the *Saturday Evening Post?* Nearly all forms of reading leave but a vague impression. If a question is raised requiring any thought or reflection, we pass it over, as we perfunctorily read the daily paper, and therefore casual reading is a minor influence.

It is my belief that other groups of health workers, whose contact with the public is wider than ours, are more active in the dissemination of knowledge relating to dental health than we are. These, by virtue of their professional, civic or humanitarian work are in a better position to convey the message than we are. In some groups, members are vested with considerable legal authority, and thus command a greater deference.

The outstanding activity, of which we know perhaps the least and which, in a measure, is the most important, is that of the parent-teacher associations. There are 20,000 units of this organization in the United States and the units range in membership from ten to several hundreds. This would give a total membership of from 200,000 to several million. The registered membership of the national congress is reported as numbering 1,134,714. This body, composed chiefly of young parents (both sexes) and the teachers and coworkers in the public and private schools, has shown definitely that its interest in dental health lies where ours should lie, with the children, and most of them can speak in the possessive sense because they are interested in their own children.

Such an interest results in activity, its object being child welfare in a wider sense. Wherever I have made a contact with these groups, I have found a keen interest in dentistry, not only because of the benefits the family will derive but also for the benefit of all the children of the community.

It would be interesting for us to know just how many school dental clinics have originated within or been established by the parent-teacher associations of America.

The most striking accomplishment in health service within this group of which I have knowledge was reported by Mrs. A. H. Reeve, president of the National Congress of Parents and Teachers, at the meeting of the American Public Health Association, in Cincinnati, in October, 1927. She reported the effort of one unit, stating that 97 per cent of the children applying for admission to school for one year had physical defects that were correctible. The organization was advised of the condition, and a campaign of correction was begun. Three years later, the health authorities reported that only 3 per cent of the children entered school with uncorrected remediable defects in that community; a complete reversal of former conditions.

Knowing, as we do, that from 50 to 85 per cent of these defects are dental and probably some of the others may be traceable to dental disorders, we can appreciate the good resulting from the activity of such organizations in dental health service.

Next in importance, in my opinion, is the American Child Health Association. Looking on the child as a whole, this group of interested workers is endeavoring to correlate all health service and education in such a manner as to give to parents the best advice, and to children the best care, in an effort toward producing a sound body and a sound mind.

At the last meeting of the American Child Health Association, there were six dentists present, four of whom participated in the program by invitation. At this time, a number of allied health societies were met in convention, and more than 2,000 workers were registered.

The policy of the American Child Health Association regarding dentistry is included in a general statement quoted from the *Transactions of the Fourth Annual Meeting,* 1927:

> It is the purpose of our President, Executive Committee and Board of Directors that this organization shall serve as a clearing house of inquiry into and information about the problems which affect child health and, therefore, the health of the nation—in fact, to become more and more a research organization. Accordingly the next big research job, with which we are already engaged, is to weigh and measure the effectiveness of the health program in the schools of the country. Is this health program yielding results in healthy children and in habits and attitudes that build health potentialities for the future? This will be a field of investigation attempting to secure more precise objective data which may be used to measure, in terms of health status, habits and knowledge of pupils, the effectiveness of existing school health activities.

The American Association of Public Health Nurses is doing as fine a piece of work as any organization in dental health service, but it is being handled individually rather than as a general policy.

The nurse in the school or health district, through a desire to keep her group well or because of some personal contact in her state or community, takes it upon herself to encourage the practice of mouth hygiene and regular dental service. She is doing much more in this field than the dental profession is.

Recently, Haven Emerson, health commissioner of New York City, gave a course of instruction to a group of sixty nurses in the summer session at the University of California. He inquired of his class as to how many consulted their physicians twice a year in matters of general health, and three or four responded in the affirmative. He then asked how

many consulted their dentists twice a year, and half of the class arose in response. This personal interest indicates their point of view in dental health service.

A public health nurse, in Madera County, Calif., having heard a lecture on the importance of mouth hygiene in childhood, decided to try it out. Without consulting anyone, she made an examination of the teeth of all the school children in her district, noting the carious teeth. These data, which correspond to the general report of 85 per cent of decayed teeth in all school children, were recorded and filed. She then instructed the children in the elementary procedure of mouth hygiene and the necessity for thorough and careful brushing. She followed up her teaching at each visit to each school. Three years afterwards, she made a second examination in the same district and found that only 56 per cent of the children had carious teeth. This, accomplished without the counsel or aid of a dentist or dental organization, speaks for the nurses' interest in our problem. Whenever I make contact with a dental hygienist engaged in school work, I learn that the public health nurse is her strongest ally in her health program.

Probably the most influential organization in the United States which is contributing something to the solution of the dental problem annually is the American Public Health Association.

Aside from its own membership of 4,600 persons, of which about fifty are dentists, this association attracts other organized health groups to its annual conventions, each of which is contributing its own particular knowledge and ability to the solution of public health problems.

Included in these are the American Association of School Physicians, the American Child Health Association, the American Social Hygiene Association, the Association of Women in Public Health, the International Society of Medical Health Officers and several local and state organizations interested in their own as well as general problems.

The American Association of School Physicians held its first annual meeting during the convention at Chicago, in October, 1928. Fourteen reports and papers were presented, and all but two, which dealt with school ventilation and Snellen tests for the eye, contained some reference to dental health activity.

Kindred interests bring these groups together. All of them are vitally interested in our problems, and yet the dentists apparently are not interested in public health. When leading bacteriologists of this country, such as Rettger, of Yale, and Kendall, of Northwestern University, formerly of the Mayo Foundation, will discuss Bunting's work on *Bacillus acidophilus,* questioning the reported results; when Fisk, of the Life Extension Institute, New York City, introduces the problem of infectious dental foci as an industrial hazard; and when Mitchell, of the American Child Health Association, will arrange a full period on dentistry as a joint program of that association and the Child Hygiene Section of the American Public Health Association, it would seem that dentists should take some interest in other fields of health education than their own.

If we expect to participate in development of the dental health program of our country, we must cooperate with other agencies which not only interest themselves in our problem but also endeavor to correlate it with their entire activity. We are not only indifferent to their health problems, which involve life and death, but we are apparently equally in-

different to our responsibility in the general health program.

I have made no mention of the dental health service carried on by the great foundations in the United States, the Forsyth Infirmary and the Rochester Dental Dispensary, for this is well known to all of you. The Rosenwald Foundation, in Chicago, adds a new unit of this type in the great central metropolis, which will contribute to our knowledge and, as the others have done, will help to guide us in the future.

Nor have I mentioned the activities in such organizations as the Boy Scouts, the Camp Fire Girls, the milk industry, the American Medical Association and many others, as their activity in dentistry is incidental rather than basic.

One hundred per cent of all the people above the age of 3 need dental service periodically and probably would be healthier if they received it once or twice a year.

This thought has been quite generally inculcated in the minds of the intelligent citizens of our country, not because they desire to consult the dentist, but because they appreciate the value of sound teeth and a healthy mouth.

In their own way, they are trying to solve their part of this problem of health service at a price within their means. They give expression to their opinions and knowledge among their friends and in various organizations. Their ideas are based upon information obtained chiefly, but often indirectly, from dental sources.

Our responsibility is clearly defined if we will but recognize it. It is twofold in character: (1) to educate all people in the importance and value of sound teeth and healthy mouths, and (2) to provide this service for all people at a cost within their ability to pay.

The widespread activity in dental health service in so many other organizations and among so many people is the signpost of dental progress at present and a challenge to our interest and ability to cope with its problems in the future.

TEETH AND THEIR RELATION TO HEALTH*

By WILLIAM J. FALK, D.D.S., Cumberland, Md.

I HAVE classified women as follows: (1) those who expect to become mothers; (2) those who at the present time are mothers of growing children. For the first class, I am going to stress the necessity of prenatal care. You who are in the second class should pay particular attention to the diet and exercise of your children and general health conditions that you can bring about in them. A third class or division does not pertain to any age or sex. It has to do with the great body of adults who have allowed custom and past prejudices to govern the care of their teeth.

Years ago, it was a recognized fact that a woman who was pregnant should keep as far away from a dentist office as was possible. The reason offered was that any dental service would serve to excite and increase her nervousness. Today, we have discarded this theory, and

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the medical profession advocates that the expectant mother visit her dentist at regular monthly intervals, just as she visits her physician, for it is during this period that the teeth have a greater tendency to decay, owing to a lack in the organic and inorganic salts that are provided them. The dentist, at this time, will prescribe the proper diet as well as care for her teeth and gums so that the proper foundation for the baby's teeth will be laid down. As it is the natural tendency for a healthy organism to reproduce a healthy one, if you do all that you can to insure your own good health, you can rest assured that the health of your baby will be all that you expect.

The condition of children's teeth depends to a great extent on the physical condition of the expectant mother. The foundation for good sound teeth is laid during the third month of intra-uterine life. As, at birth, the crowns of the deciduous or baby teeth are practically fully formed, and about one-fifth of the crowns of the permanent teeth are already formed, you can readily see that the first step toward good teeth in children is proper care and diet for the expectant mother. The teeth demand for their structure large quantities of mineral salts, which are found in whole milk, fresh fruits and green vegetables, such as spinach, lettuce, carrots and celery. Other necessities for normal tooth conditions are: rest, hygienic care, fresh air, sunlight and limited exercise of the proper sort.

The first deciduous tooth will make its appearance about the sixth or seventh month after birth, and the last one will erupt about the second year. When the child is 2½ years of age, he should have all of his deciduous teeth. This is the ideal time for the child to make his first visit to the dentist, and from then on, he should be seen every six months, in order that the dentist shall not only come to be regarded as a friend instead of the age-old, feared bogey man, but also that he shall be able to care for the child's teeth in a manner pleasing to the child. This is one of the few ways of overcoming the fear that the child usually acquires and will prevent some mothers from making the threat that if the child doesn't behave, she will take him to the dentist.

The result of a recent survey shows us that from 50 to 70 per cent of grade-school children have irregular or crooked teeth. A very small percentage of these cases were inherited. As it is Nature's tendency to reproduce perfect forms and to restrict the reproduction of imperfect ones, if we take the proper care of the teeth, we need not worry about our children inheriting poor teeth.

The tongue, lips and cheeks form the mold for the teeth, the tongue serving to force the teeth outward as they erupt and the lips and cheeks serving to balance and check this outward pressure. If these two actions balance, the result will be a perfect set of teeth.

The pressure exerted by the erupting of permanent teeth, from within the jaws, as they slowly make their way toward the gums to take their place behind or to replace the deciduous teeth, contributes largely to the growth of the jaws. Thus, if the deciduous teeth are lost prematurely, this pressure is lessened, and the permanent teeth either erupt too soon or else the baby teeth are forced forward, and thus the space is lessened and the permanent tooth either erupts in malposition or becomes impacted. On the other hand, if the deciduous teeth are retained over a prolonged period of time, the permanent teeth will erupt at a point other

than their normal position, with a resultant malocclusion.

The improper habits of eating, breathing and sleeping contribute largely to the cause of crooked teeth and ill-formed jaws. We can classify these habits thus:

1. Habits which disturb the proper coordination between the lips, cheeks and tongue. These are mouth breathing, lip sucking, cheek biting, etc. Lip sucking serves to force the upper teeth outward and to separate them, while the lower teeth are forced inward. The lower lip usually becomes thickened and unsightly. Cheek and tongue biting gives us what is known as the open bite, i. e., the child is unable to bring its teeth into occlusion. Mouth breathing gives us somewhat the same appearance that lip sucking does. The upper anterior teeth are protruded, but usually are not separated. The adenoids are subject to stimulated growth, and as a result the child has difficulty in breathing.

2. Those habits which, from an exerted force, serve to disrupt the proper alinement of the jaws, or which push the teeth in some position other than normal. These are thumb sucking, improper nursing, the use of pacifiers and bad sleeping habits. Thumb sucking also forces the upper anterior teeth outward and the lower ones inward. Improper sleeping habits, such as sleeping with the hands or arms under the face, will cause the jaws to be pushed to one side or forward or backward, this depending on the position in which the child sleeps. Sleeping on the back is the proper position for the child.

Nursing plays an important part in this stage of development. Every baby should, if possible, be breast fed, not only because it will thus receive its natural food, but also because of the exercise provided for its tongue and jaws which is not provided for in bottle feeding. If breast feeding is not possible, a feeding bottle of the wide mouth type, with a short stubby nipple, should be used, in order to prevent the child's forming nipple habits, which so often happens when a long narrow nipple is used on a small mouthed bottle. It is not necessary for me to tell you about pacifiers, for today the word itself is taboo with any well-informed mother.

Let us now consider the growing child at the age of 2 or 3 years. Decay in a child's tooth at this time should be taken care of as soon as it is noticed. Decay causes toothache, and loss of nerve substance within the tooth, with some sort of systemic disease as the result in many instances. Loss of the teeth due to lack of attention will cause drifting of the other teeth, thus disturbing their biting efficiency. Premature loss of the baby teeth will cause all kinds of irregularities in the permanent set. It is extremely important that cavities in the deciduous teeth be filled as soon as they are discovered, because:

1. The food must be properly masticated to assure proper digestion, and the only way that this can take place is to have the teeth in a sound condition.

2. If they are not filled, the cavities will enlarge, and the nerve will become infected, some major or minor disease following.

3. Cavities are the ideal breeding place for germs; especially those that cause measles, diphtheria, scarlet fever, etc.

4. The deciduous teeth must be preserved and thus retain the proper space for the permanent set.

For the child at this age, three meals a day are sufficient. Teach him to masticate his food well and not bolt it. He should eat firm, fibrous foods to insure efficient tooth cleaning. If the child par-

takes of mushy foods or sweet stuffs, some sort of cleansing food, such as lettuce, celery or dry toast, should follow. In this country today, ninety-eight of every hundred children have decayed teeth. This is due in a large measure to the improper diet of earlier years. Have your child's diet consist of plenty of milk and butter, fresh fruits, green vegetables, some meat and plenty of coarse cereals. If you must feed him candy, give it in small amounts immediately after the meal. Then have him brush his teeth. The child should exercise in the fresh air and, above all, he should be exposed to the sunlight as much as possible.

The average adult dreads the dentist as much or, in some cases, even more than the child. Some of you go to the dentist with the idea of getting your teeth cleaned, so that they will sparkle when you smile. When your dentist offers the suggestion of a thorough prophylaxis, you immediately discourage the idea and repeat that you only want your teeth cleaned. Years ago, prophylaxis meant, to most of us, just a little scraping and brushing, but today it includes a much broader field. It is concerned with preventing diseases of the mouth, and in order to prevent such things, we must place under this heading a thorough examination of all the hard and soft tissues of the mouth, the filling of all tooth cavities, treatment of the gums and thorough removal of all tartar and other deposits.

The average person today reads the newspaper and magazine advertisements, and as soon as they see an "ad" with the large caption, "Four out of five have it," or some such similar stirring announcement, they immediately acquire what I term a pyorrhea complex and, before long, every time they pass a mirror, they give the gums a worried push or squeeze, and then if these tender tissues show any signs of bleeding after this rough treatment, they are sure that they are one of the afflicted four. After a few months, this psychologic disease gains a hold, and the dentist has another patient on his pyorrhea list. I cannot condemn these spectacular advertisements sufficiently. Here is an illustration of a case that proves to us the power of the press in regard to "patent" medicines and tooth pastes. It is one of the most striking examples of not only the inaccuracy but also the utter absurdity of some of these published statements. "In the same issue of a newspaper, there appeared a strong testimonial of a patent medicine by a man who claimed that he had been greatly benefited by its use, and in another column a notice of this man's funeral. Thus, while one statement proclaimed that the man was marvelously improved in health, the other said that he was dead and buried. The manifest assumption is that the editor and the advertising man failed to have good teamwork."[1] Let your dentist and not some publicity man advise you what dentifrice and mouth wash is best suited for your mouth.

"Never put off until tomorrow, what you can do today," is an old adage, but did you ever apply it to your teeth? You have a guilty feeling that your teeth need dental care, but you say, "Oh well, I guess I'll go see the dentist tomorrow," but tomorrow never comes until one of those neglected teeth takes the trouble to send you a night letter in the form of a severe ache, and then you say, "Oh, why didn't I see my dentist last month when I thought of it?" Remember that now is the time to see your dentist.

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1. The Struggle Up, Editorial, J. A. D. A., 16:1713 (Sept.) 1929.

Your teeth work for you faithfully. Whenever you call on them to work, whether it is chewing gum or biting hickory nuts, they are there to serve you. Why not reciprocate and clean them as regularly as you eat? Use a good toothbrush; one that is recommended by your dentist and not one that is sold to you by some drug clerk who is anxious to make a larger margin of profit for his employer by selling you some inferior article.

After you have purchased this brush, don't try to see how long you can make it last. Use it for two months and then give it a permanent rest. Destroy it so that you won't be tempted to use it all over again because its bristles are so nice and soft that they never hurt your gums. Keep your brush in a separate rack away from the rest of the family's brushes and thus avoid contamination. If you want to enjoy good health, tomorrow or next week will never do. See your dentist at regular intervals. "Be true to your teeth or they will be false to you."

KAPAA SCHOOL, KAUAI, HAWAIIAN ISLANDS

By HELEN M. BAUKIN,* Honolulu, T. H.

AS a paramount factor in education health measures are steadily increasing in the schools of the Hawaiian Islands. Kapaa School, one of the outstanding schools in health work, is located on the Island of Kauai. Mr. George S. Raymond, principal of this school, is vitally interested in the health of the pupils, and it is a great satisfaction to visit the school and to see the systematic program of health education so satisfactorily carried out.

Kapaa School is the second largest school on the Island of Kauai, having an enrollment of 855; this number being well cared for by Mr. Raymond and his thirty assistants. Beside the regular staff of class room teachers, Kapaa School has the following as fellow workers: Miss Bernice E. L. Hundley, supervising principal; Miss L. I. Ellis, primary supervisor; Miss Pearl Shackelford, nutrition worker; Miss Motome Kamei, dental hygienist; who spend about four months each in the school; Clinton Rockey, school dentist, who spends four months every eighteen months or two years in the school; H. T. Sheldon, deputy sheriff; A. W. Boyden, government physician; Miss H. F. Calvert, public health nurse; M. R. Aguiar, Jr., supervisor; Judge William C. Achi, Jr., of the juvenile court; Herman Diamond, probation officer; Joseph Correa, district magistrate; A. P. Christian, chief sanitary officer; Will C. Crawford, superintendent of public instruction.

The school grounds (11 acres) are spacious and well kept. There is one main building, which houses nine class rooms, and the principal's office. Eighteen bungalows, attractively placed in U-shape to the side and rear of the main building, care for the remaining number of children.

A very attractive house, which formerly was the home of the principal, is

*Supervising Dental Hygienist.

now being used for a Smith Hughes class in vocational homemaking. This class is conducted under the Smith Hughes' Act and teaches the girls all the fundamentals of homemaking. A large new building, recently added to the plant, houses a school kitchen, which enjoys an electric refrigerator, the gift of a school friend, a large dining room, an auditorium and a dispensary. The auditorium floor is 44 by 90 feet and was built at a cost of $15,000. There is a 7-acre park for a playground, opposite the school. Beside, there are a carpenter shop, a science building and a garden, which this year took first prize for the best school garden on Kauai Island. In addition, there are three teachers' cottages and one principal's cottage.

Fig. 1.—Toothbrush drill.

There are so many interesting projects in process in Kapaa School that it is difficult to do justice to them all. It has been with interest that the development of each health measure has been so carefully studied. To Mr. Raymond belongs the credit of being the first to establish the daily toothbrush drill for the primary grades in the school. It has now become as much a part of the school work as reading, writing or arithmetic, and before any of the foregoing studies are pursued, the teeth must be brushed. These drills are conducted and carefully supervised by the various teachers. The care of the brush is carefully taught, and it is a pleasure to see the rows of brushes hanging in the sun for two or three hours and then carefully put away. Mr. Raymond was also the first to abolish the use of polished rice in the school kitchen, and replace it with the unpolished rice. In this country, where rice is one of the main dishes of the diet (because of the Japanese and Chinese population), this

replacement was very difficult. First, the storekeepers could not understand how anyone could possibly prefer the brown rice to the clean white kernels, nor did the parents see the wiseness of this change. However, the change was made, and only unpolished rice is served in the school cafeteria. The desire for it has also spread into the homes, and to a great extent it has gradually taken the place of the polished rice. Bread from whole grain is the only kind served in the kitchen. Here, I should like to comment on the excellent work carried on by two of the teachers, which I can best do by submitting a paragraph from a letter recently received from Mr. Raymond:

> Two teachers, Miss R. M. Brady, Opportunity Room, and Mrs. Alice M. Roderiques, Grade IV B, serve whole wheat each morning at 10:15. In Grade IV B, thirty-one pupils take this whole-wheat meal. The whole wheat, which sells for 3 cents a pound, is cooked with prunes and raisins. The pupils in IV B pay 1 cent a day for this food. The cooking is done for four hours in the teachers' cottage. Kerosene is brought from homes of the pupils in lieu of cash. Miss Brady has served meals in her room for two years. The children like the taste of the wheat and enjoy their midday meals.

When on a visit to Kauai in February, I was extremely interested in this midmorning whole-wheat meal project.

Fig. 2.—Rest period.

In Miss Brady's room, which is the Opportunity Class, the children very interestingly told me of the entire process of preparing this meal, from the careful washing of the kernels to the proper serving.

There can be no question as to the value of cultivating habits of proper diet and cleanliness in Hawaii. So many of the children come from homes of little

means, and the use of whole wheat or unpolished rice is of financial as well as dietary value.

The sale of milk daily is fifty to eighty cups a day (1-16 gallon and two crackers daily for 4 cents). The school buys 5 gallons of fresh milk each day for cooking and midmorning lunches. In the rural districts, it is often difficult to obtain milk in large quantities; hence, the foregoing amount is considered very satisfactory. The following item from the school paper will give an idea as to the cost of serving the milk:

"The school pays 0.0375 cents for each cup of milk and 0.008181 cents for each two crackers sold. That is a total of 0.045681 cents for milk and crackers. The kitchen loses about one-half cent on each sale. At the present time, the loss is 0.46248 cents a day for eighty children."

Kapaa School also has supervised daily rest periods, and when the weather permits, these periods are taken outdoors. Regular surveys are made as to gain in height and weight.

The kitchen and dining room are well equipped and cater to all children who desire to purchase their noonday hot meal at school. These meals are carefully planned from a nutritive objective and are sold to the children for 5 cents. The dining room is furnished with long tables and benches, where the children sit during the meal. This practice teaches them the use of table utensils as well as proper table manners.

The following are items written by children and taken from various numbers of the *Kapaa School Bulletin,* which is published weekly:

COD LIVER OIL FOR COLDS

Coughs and colds can be largely prevented by cod liver oil. This oil is somewhat like the sunshine and like sunshine, it helps to build vitality and resistance to infection, particularly infection of the nose, throat and lungs. Both sunshine and cod liver oil make the bones grow straight and strong and protect children against rickets. Cod liver oil is good for both grown persons and children because it increases the general resistance of the body to disease.

JANUARY MEALS

The Kitchen served 7,527 meals during the month of January. This was an average of 368 daily.

MY HEALTH

I have made a health chart in my class room, to see whether I keep up with my health. Every small recess I go outside and sit down to eat my morning lunch, then I rest a little while under the trees. When the bell rings to march to the rooms, I go outside and have a good time with Mr. Cod Liver Oil. He always tells me to drink a tablespoon of him because he will build up my bones and teeth while I'm growing.

LUNCH SALES

September	306
October	334
November	357
December	352
January	368
February	369
March	430
April	497

ARMY CHOW

The school kitchen served 7,952 lunches in 16 April school days. This was 497 a day.

EAT WELL

We have hot lunches. Milk and chocolate on sale daily. Prices low on all high grade goods.

AQUA

Water is such a common part of our environment that we seldom appreciate its value. When we get thirsty and find ourselves in a place where we cannot get a drink of water, we begin to realize what a great pleasure it is to have plenty of it to drink. You have probably been told to drink water several times a day. Perhaps you have grown tired of hearing your doctor, parents, or teacher tell you frequently of its importance. Some biologists have said that water-drinking is one habit that we are likely not to overdo.

ORDER BEST

The cafeteria is hard to get to with the stage settings. Yet, no one complains. It is a big attitude to take. Get along the best you can as things are. A little patience and you can get a lunch. Thank you.

BEST HEALTH

Survey made May, 1928:

Grade	*% Underweight*
2A	10
One E	11
8B	12
4B	14
One B; One D; 3A	15
3B	16
Home School	18
6B; 8A	19
One A; 6A	21
One F; 2B; 3C	22
2C; 4C	23
Opportunity Class	25
Average 26 classes	21

Improvements made since March:

3A	Gain of 57
Home School	Gain of 57
One D	Gain of 52
2A	Gain of 47
Opportunity Class	Gain of 40
2B	Gain of 35
One F; 3B; 4B	Gain of 33
8B	Gain of 29
7A	Gain of 23
One E, 5B	Gain of 21
4C	Gain of 20

All classes except three gained since March. School gained 29%.

THE VALUE OF REST

Rest is one of the most important elements of hygiene. Few of us know that rest gives the little cell builders a chance to carry on their work successfully. If we school children do not have enough sleep we may become pale and weak, dull in our studies, backward in lessons and sometimes lack an interest in everything. To prevent this dreadful breakdown we should have enough sleep, in as much fresh air as possible, and a dark quiet room, and then sleep peacefully, soundly, and happily. Remember, rest is needed to equalize the circulation of the blood, to give time for the washing out of fatigue poisons, and to give the nerve cells a chance to recover before new work is undertaken.

FIRST CLASS

The Vocational Homemaking Class this year has seven girls who finished the two year course. This is the first class in homemaking to be graduated on Kauai. We hope them further success in life. They know how to cook and sew—that's a great deal.

VOCATIONAL EDUCATION

Report of industrial classes at our school for December, 1927:

Carpentry and shop	208
Gardening	443
Cooking	146
Sewing	292
Primary hand work	447
Mechanical drawing	83
General science	52
Printing	7
Weaving	29
Agriculture	30

RACIAL ANCESTRY
(Class of 1928)

Japanese	31
Portuguese	10
Hawaiian and Part Hawaiian	7
Filipino	3
Chinese	2

Average daily attendance—Kapaa School —94%-95%.

Average distance walked by pupils—3 miles (to and from school).

With the academic and health work, all the principles of right living are taught, combining healthful play with healthful work. Loyalty to his fellowmen as well as to his country, is greatly stressed. Each morning, the entire school stands at attention as the Stars and Stripes are raised, and with unfaltering voices, these children of numerous races pledge allegiance to Old Glory. For the outsider, whose privilege it is to be present at the Flag raising exercises, the heart beats faster to hear the many children of many ages and many races slowly and emphatically pledge:

I pledge allegiance to the Flag of the United States and to the Republic for which it stands; one nation, indivisible, with liberty and justice for all.

ANNOUNCING ATTRACTIVE NEW POSTERS

The Bureau of Dental Health Education now has ready for distribution two new rocograph, nine color posters. They are attractively designed to encourage the care of children's teeth.

As a matter of economy, two versions of the same poster have been developed; one is adapted for appeal to parents, the other for the attention of children. The first mentioned version is more suitable for public displays, clinics, etc., where adults would be most apt to see it. The latter can be used in the school room, school dental clinics, and in other places where children would be most apt to view it.

These posters are 20 by 30 inches and are made of a heavy fiber cardboard. The work of the artist is skillfully reproduced in nine colors. These posters were prepared by the celebrated rocograph process, pure oil paints being employed, making the posters very durable and permitting wiping with a damp cloth or washing with soap and water.

Either one or both of these excellent posters will be shipped to you in a specially prepared cardboard carton. Because of the purchase of a large quantity of these posters, the Bureau of Dental Health Education is enabled to sell them at the remarkably small sum of $1.50 apiece, shipping costs included. Money must accompany order.

Address all orders to: Bureau of Dental Health Education, American Dental Association, 58 E. Washington St., Chicago, Ill.

HEALTHY
and
Happy!
Fairy Good Health whispered, "Go, my dear,
And visit your dentist twice a year.
Look after your first teeth, and second teeth too,
And grow healthy and happy!" So I do. Don't you?

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Agranulocytosis: The first case of agranulocytosis to be reported in Japan, and the youngest case to be reported up to that time, is presented by Tokue and Yasumoto *(Am. J. Dis. Child.,* November, 1929). The patient, a boy, aged 4 years, had the following symptoms: high fever, characteristic yellowness of the skin, nausea and vomiting, marked *fetor ex ore,* several bacterial emboli on the skin, *Staphylococcus aureus* in pustules, positive reaction of bilirubin, urobilin and urobilinogen in the urine, no hemorrhagic diathesis and no involvement of the joints, and a blood picture showing marked leukopenia with scarcity of granular leukocytes; normal blood platelets; anemia, and erythropoietic function present. The pharynx was slightly injected, the tonsils were not coated and there was a grayish white coating on the buccal mucous membrane. The patient lived nine days. Only five cases occurring in childhood have been reported, all in boys, the oldest 7 and the youngest 3 years.

Progeria: A case of progeria (premature old age) is reported by Curtin and Kotzen *(Am. J. Dis. Child.,* November, 1929). The child, a girl, aged 7, was stooped, with rounded shoulders, a large, narrow chest and protuberant abdomen. The facial expression of childhood was lacking and the gait was shuffling. The voice was high pitched. The patient was extremely sensitive to heat and cold and tired very easily. She was underweight. A few scattered downy white hairs were present on the scalp. There were no eyebrows or eyelashes. The lips were thin and the tongue was clean and moist. The teeth were crowded but were in normal position. A number of the upper teeth of the deciduous set were decayed; the lower teeth were in good condition. The palate was high and rather narrow. The throat was clear, with small buried tonsils. The lower jaw was small, the chin rounded and not prominent. The chest was narrow and flaring below; the clavicles were small but prominent, and the scapulae were of the wing type. A marked Harrison's groove was present, and the ribs stood out prominently. There was no rachitic rosary, but the costal cartilages lacked the normal resiliency and gave the impression of extreme brittleness. Roentgen ray examinations of the skeleton showed some evidence of premature ossification, especially of the epiphyses of the elbow joints, the growth of which was much advanced for the child's age. The shafts of the long bones were thin and showed a lack of periosteal growth at some period. The growth of the intermembranous bones of the cranium was well advanced, that of the bones of the face was far behind normal. The development of the teeth had kept pace. The child died from a heart condition, and necropsy was refused. The true nature of the disease is an unsolved problem, but the authors feel that arguments in favor of disease of the suprarenal gland have the most foundation in fact.

Sinusitis and Fatal Meningitis Due to Vincent's Spirillum: A case is reported by Seecoff *(Arch. Otolaryngol.,* October, 1929) in which death occurred four days after the onset of symptoms of orbital and meningeal complications due to the extension of infection from the accessory nasal sinuses. Necropsy revealed chronic infection of the frontal, ethmoid and sphenoid sinuses; osteomyelitis of the frontal bone; cellulitis of the left orbit; localized meningitis and pulmonary gangrene. In all these locations, Vincent's organisms were present in association with other bacteria. The intracranial lesions appear to have resulted from the spreading of the infection in the sinuses through the diploe of the frontal bone, and the pulmonary lesion from aspiration of it from the throat.—Abstr. *J. A. M. A.,* Nov. 23, 1929.

Relation Between Dentition and Fever: From a study of the case reports taken at the pediatric clinic of the University of Würzburg during the past twelve years, Helmerich *(Arch. f. Kinderheilk.,* Aug. 20, 1929) con-

cludes that there is not an etiologic relation between dentition and fever. Because of the frequency of the two conditions in infants, their coincidental concomitance is common, but the absence of fever in many carefully observed teething infants proves that the relation between the two conditions is not etiologic.—Abstr. *J. A. M. A.,* Nov. 30, 1929.

Cancer: A paper based on the last 250 case histories in the files of the Cook County (Illinois) Hospital is presented by G. W. Boot *(Illinois M. J.,* November, 1929). Cases of cancer involving the regions of the eye, ear, nose, throat, larynx, trachea, bronchi, lungs and thyroid are included. There were more than seven times as many men as women affected. In the order of frequency, the organs involved were the esophagus, tongue, lips, lung, larynx, tonsils, antrum, face, mouth, auricle, eyelids, thyroid gland, orbit, mandible, epiglottis, cheek, branchial cleft, septum, sarcoma of antrum, other sinuses, neck and pharynx. As to the age incidence, one patient was 20; from 21 to 30, there were two patients; from 31 to 40, fourteen cases; 51 to 60, seventy-eight cases; 61 to 70, seventy-four cases; 71 to 80, fifteen cases; 81 to 90, two cases. The condition was five times as common in smokers as in nonsmokers, and about three times as common in users of alcohol. The incidence was the same in syphilitics and nonsyphilitics. Eighty-five had bad teeth. Thirty-one had had several or all teeth extracted. Only three were noted to have good teeth. "Most of the mouths were veritable cesspools." Eleven had had injuries that seemed to stand in causal relation to the condition. Among them were cuts, bites, burns, sunburns and injuries from poorly fitting dental plates. Familial occurrence was admitted in six cases and denied in sixty-seven. As the cancer was usually in different parts of the body, it does not seem that heredity enters into consideration. The author concludes that injury seems to have some effect in locating the tumor and that a filthy condition of the mouth seems to have been the chief factor in starting the lesion and deciding where it should be located. He adds: "I am convinced that cancer is the result of a slow biochemical action on the developing epithelial cells, that it may be caused by more than one thing, and that time is an essential part of it; a slow absorption of some chemical substance into the blood and other fluids of the body that bathe the developing epithelial cells, or a slow physical action by sunlight, radium or x-rays. It is more than possible that a slow absorption of mild toxins from the organisms developing in carious teeth, in root abscesses and in pyorrhea, as well as developing in chronically infected tonsils, particularly in the patients who have carious teeth, pyorrhea and infection of the tonsils, plays a large part in the slow biochemical changes that start cancer. The absorption of these mild toxins must go on for quite a number of years before they have sensitized the germinal epithelial cells to the point where a little added stimulation in the form of irritation inaugurates the cancerous proliferation that does not cease until the cancer is removed or the patient's death results."

The Anesthesia Problem: Recent advances in methods of inducing anesthesia have brought in ethylene, a splended and safe anesthestic, which is much less irritating than ether, but which does not always produce quite so complete relaxation. It can be readily combined with ether, or can be used to follow nitrous oxide, and although it has the disadvantage of being extremely inflammable, in a period of years we have had no accident of any kind from its use. . . . Lundy and McCusky and their co-workers have found the use of combinations of general anesthetics of various types, especially of ethylene with ether or nitrous oxide, in connection with local anesthetics, to be the procedure of choice in a very considerable number of cases. In all cases, liberal amounts of oxygen have been found advantageous. . . . With the new anesthetics, for instance, the sodium salts of barbituric acids, and others of that type, we at least have achieved a scientific method of injecting the anesthetics intravenously, thereby relieving the lungs and other organs of certain dangers to which we have become so accustomed as almost to have forgotten the reason for their existence. The Clinic is indebted to members of the staff, first to Dr. Sistrunk and later to Dr. Balfour, for making careful use of sodium iso-amyl ethyl barbituric acid. This agent is not the perefct anesthetic, but in several hundred cases in which it has been used under the direction of Dr. Lundy and his co-workers, we have had no fatalities that could be traced to the anesthetic. Our experience with sodium iso-amyl ethyl barbituric acid demonstrates that direct methods of producing anesthesia may soon be expected, which, in connection with a proved method of

inducing regional anesthesia, will relieve the patient of unnecessary dangers to unoffending organs. Certainly, as far as sodium isoamyl ethyl barbituric acid is concerned, the speed with which the patient drops to sleep, and the freedom for some hours after operation from all painful sensation, has led many patients who have had unpleasant experiences with general anesthetics, to plead to be operated on under this newer form. Regional anesthesia by procaine has a large and growing field of usefulness, and is very efficient and safe.—W. J. Mayo, in *Staff Meetings of the Mayo Clinics.*

FOREIGN LITERATURE

Experimental Investigations on the Question of Remineralization of the Enamel by the Saliva (R. Weber, Ztschr. f. Stomatol., 27:912, No. 10, 1929): The enamel, owing to its very small content of organic matter, has been considered a hard substance without metabolism. The dentin, on the contrary, as it is in its structure very similar to the bone, is considered to undergo a kind of metabolism, though a rather slow one. The metabolism of the dentin is closely related to the metabolism of the living pulp. This can be shown especially by the changes in the chemical qualities of dentin in cases of avitaminosis and by the changes in density of the dentin during pregnancy and at different ages. For the enamel, another kind of "metabolism" has been suggested in the last few years: the process of osmosis and diffusion, by which some substances might be able to penetrate the enamel from the side of the pulp and dentin as well as from the saliva. The influence of the saliva on the enamel has been considered as a demineralization as well as a remineralization. It has been pointed out (by Hoppe-Seyler) that the already formed human enamel continues to undergo changes after eruption, and these changes have been considered as a kind of "ripening," which means that the enamel obtains its allotted amount of calcium salts by way of the saliva ("mineralization"). On this conclusion, the theory of "remineralization" (Head-Pickerill) has been based. Head and Pickerill claimed that, even if the enamel becomes decalicified superficially during life (owing to the presence of diluted acids), it can become remineralized by the saliva. Head made the experiment of decalcifying extracted teeth superficially by keeping them in orange and lemon juice. These teeth, afterward placed in saliva, were supposed to regain their former hardness and luster. Whether this phenomenon is really based on decalcification and on recalcification has never been proved. The author (Weber) made an experimental investigation by exact chemical methods to find out whether there is a real basis for the idea of remineralization or not. He tried to determine, in a long series of experiments, whether there is a change in the calcium content of a tooth in various solutions, and how this calcium content can be changed by chemical means. He kept normal young teeth in saliva for different lengths of time. In these experiments, no changes of the calcium content, neither in the teeth nor in the saliva, could be found. In another series of experiments, he decalcified teeth superficially in diluted citric acid for two weeks and kept them for another two weeks in saliva. In these experiments, he could not find any remineralization by the saliva. On the contrary, the decalcification caused by the acid was continued in the saliva, so that the saliva contained more, and the tooth less, calcium at the end of the experiment.

It is not possible here to enter more into the biochemical details of this paper, which are of great importance for every worker in this field. Weber's conclusions are that by an exact biochemical investigation, there could be found no evidence for remineralization. On the contrary, it was proved that a superficially decalcifed tooth continues to secrete calcium salts into the saliva. It could not be experimentally proved that the saliva can furnish calcium salts to the enamel.

RUDOLF KRONFELD, Chicago.

Mistakes in Prosthetic Dentistry (Ludwig Kohler, Fortschr. d. Zahnheilk., November, 1929, p. 1015): The mistakes that are still too common in the construction of crowns and bridgework can be summarized under three heads: 1. Poor adaptation of crowns at their gingival margins. 2. Construction of bridge dummies with bases that are too large. 3. Building of contact points that are too broad and fine both between dummies and between dummies and supports. Irregularities of the nature described result too frequently in pyorrheic conditions, which sooner or later bring about the loss of the teeth supporting the restorations. Proper construction of crowns and bridges will with certainty prevent such troubles. To build

strong and yet limited contacts between the different bridge members, iridioplatinum bars embedded into the occlusal contacts and soldered will serve admirably. Much damage is also done to the teeth from the use of partial dentures. This results from (1) uncleanliness, (2) effect of the clasps and (3) settling.

EMIL MUELLER, Chicago.

Fractures of the Jaws (Hans Moral and Hans Schlampp, Fortschr. d. Zahnheilk., November, 1929, p. 1055): The occurrence of jaw fractures is today steadily on the increase. It is a regrettable fact that too many jaw fracture cases still fall into the hands of general surgeons for treatment. Only a surgeon trained also in dentistry is best able to construct the special appliances that are usually indicated in the treatment. When fracure cases are first encountered, a systematic general examination should be made. In order to determine whether the patient is otherwise sick or not, a quick general inspection should be made. One must decide whether the case involves only a fracture or other more serious injuries resulting from accident that might threaten the life of the patient. The heart and circulation should be examined; next, the central nervous system, and then skin and organs such as eyes, ears, nose, as well as abdominal organs. Subsequent to the previously outlined examination, there should be inspection and palpation of the jaws. Within the first half hour, unless it is definitely decided that it is not required, tetanus antitoxin should be given, because of the many ways in which wounds may become infected even though there has been no direct contact with the soil. Fracture treatment should be undertaken as soon as possible. Teeth in the line of the fracture should be removed in order to avoid complications in the healing process. Complicated appliances should not be used if reasonably good results may be obtained by the use of simple appliances. In conjunction with the commonly used appliances and methods of wiring, some attempts have been made to reduce the healing time and strengthen the callus, by the administration of some of the drugs now used to aid calcification. While results thus far vary greatly, some very good results have been reported. Often, we find peripherally to the point of fracture of the jaw a hypesthesia, which frequently turns into a complete anesthesia. This is sometimes brought about by pinching of the tissues by the fracture. Partial or even complete anesthesia from this source clears up within a short time. The condition in those cases in which the manibular nerve is injured is quite different. There are two ways in which injury may occur to the nerve. A pressure injury to the nerve may result from an intracanal hematoma or the nerve may be directly severed by the fractured bone. A partial or complete anesthesia from a hematoma is more readily repaired than a similar condition resulting from complete breaks of the nerve. A complete break is usually followed by a considerable period of complete anesthesia. While this may annoy the patient, absolute assurance may be given that this is of no serious significance.

EMIL MUELLER, Chicago.

Dental Metallurgy (Friedrich Schoenbeck, Fortschr. d.Zahnheilk.,October, 1929, p. 915:) This study is confined to the phase of dental metallurgy which deals with the changes metals undergo during the casting process. The greatest difficulty encountered in such a study is the fact that the metals are not transparent. To overcome this difficulty, G. Tammann utilized salts for the study of these changes, since these are transparent. Upon the basis of these studies, it is now possible to explain the structural changes found in the metals after casting. It was found that the hardening of salts takes place from so-called crystallization nuclei. These are irregularly distributed throughout the mass and serve as crystallization centers. Crystallization extends from these centers in all directions. The crystals are limited in their extension by other crystals in the mass. The borders where the crystals are limited by one another are known as border zones, also called crystal border zones. During the hardening of the mass, it assumes a crystalline granular structure. The size of the granules is governed by cooling rate. The more rapid the cooling rate, the smaller the granules will be. The casting golds largely contain gold, silver and copper. These metals, in the right proportion, form homogeneous crystals. When a casting alloy is hastily hardened, the rate of cooling not only influences the number of the granules in the mass but also governs their composition. When gold alloys are rapidly cooled, the first layers of the crystal granules formed are richer in gold than the subsequent layers. This results in a

mass of irregular consistency which will corrode and discolor readily under saliva. Slow cooling is desirable, first, because it prothe right proportion, form homogeneous crystal granules, which means a denser and stronger mass, and, secondly, because it will result in a more uniform alloy and one which will resist corrosion and discoloration. It is quite generally known that golds should not be unnecessarily heated because the alloy becomes oxidized. It is the copper as well as the gases from the flame that form the oxidization products. These are melted into the mass and, during the hardening process, lodge between the crystal granules. These influence the density of the mass and therefor reduce the mechanical resistance. Sometimes, these oxidization products are dissolved and form gases in the mass which are given off during the cooling process and result in porosity of the casts.

EMIL MUELLER, Chicago.

MISCELLANY

BOOK REVIEWS

Ultraviolet Light, and Vitamin D in Nutrition. By Katherine Blunt, President of the Connecticut College; formerly Chairman of the Department of Home Economics, the University of Chicago, and Ruth Cowan, Instructor in Home Economics, the University of Chicago.

Thirty-eight illustrations, 229 pages; price, $2.50. Published by the University of Chicago Press, Chicago, Illinois.

This is one of the Home Economics Series of the University of Chicago. There is an interesting foreword by Morris Fishbein, editor of the *Journal of the American Medical Association,* which touches briefly on some of the significant factors connected with the subject. Just now, there seems to be an unusual interest in the question of calcium and phosphorus of the body and the authors have devoted an entire chapter to this topic.

Of course, to dentists the chapter that will be found of greatest interest is the one on "Tooth Development and the Antirachitic Vitamin." This is very interesting, though certain of the deductions cannot as yet be accepted without question. The statement is made that "Not until about 1925 was it possible to demonstrate the existence of a circulatory mechanism inside the tooth which allows for its continuous nutrition both during growth and after full growth has been attained, and also for withdrawal of calcium and phosphorus in time of stress."

Without wishing to question any of the recent research on this matter, we may venture the opinion that not even until 1930 has it been demonstrated that the calcium and phosphorus are withdrawn in time of stress. This takes us back to the old theory that the teeth sometimes decayed more actively during pregnancy than at other periods of life owing to the extraction of lime salts from the teeth of the mother to build up the teeth of the child. Such a theory was greatly discredited when it was found that proper hygienic care of the mother's mouth and teeth during pregnancy reduced the incidence to decay very materially. Another difficult nut for the protagonists of this theory to crack is the fact that a pulpless tooth has the same reaction toward the carious process as has a tooth with the pulp alive, and the widest stretch of the imagination could never conceive of a pulpless tooth having a circulation. The most significant factor in caries of the teeth is the environment in which the teeth are placed rather than the character of the tooth structure itself, and it is safe to conclude that the teeth are not depleted of their lime salts by the circulation, nor are lime salts built into them at the will of the dietitian.

This book as a whole is an exceedingly creditable volume and will well repay a most careful study.

The Medical Museum, Modern Developments, Organization and Technical Methods. Based on a New System of Visual Teachings. By S. H. Daukes, O.B.E., M.D., D.P.H., D.T.M. & H., Director of the Wellcome Museum of Medical Science, Affiliated to The Bureau of Scientific Research. An Amplification of a Thesis read for the Degree of M. D. Cambridge. 172 pages, illustrated. Published by The Wellcome Foundation, Ltd., Endsleigh Court, 33, Gordon Street, London, W. C. T. England.

The great value of medical museums is not confined to the concrete benefit to the

medical profession, but through this agency, there is the possibility of a widespread extension of knowledge to the laity. In fact, it is frequently only by this vivid method of demonstration that the average lay individual can be made to visualize many of the disease processes with which he really should be familiar. If a conviction can thereby be carried to the public as to the necessity for taking precautions against disease, a great gain may be registered in the health of the people. No printed literature can ever quite convey to the reader the same effective lesson as can an actual demonstration by illustrations, specimens and models as presented in a museum, and therefore the better worked out the general plan of a museum, and the more intelligence that is put into its every detail, the greater good it will do.

Dr. Daukes has brought to his task a wide experience in this work and the reader must be impressed by his comprehensive grasp of the subject. The chapter on "The Museum of the Future" is especially pertinent and instructive, offering suggestions of practical value. Everyone interested in creating a museum should read this chapter.

The illustrative portion of the work is instructive and interesting, showing the scheme of arranging and presenting many of the topics for the most vivid portrayal of the subject being exhibited.

The printing and mechanical makeup of the work is beyond all praise, reflecting great credit on the publisher.

The Physiology of Oral Hygiene and Recent Research, with Special Reference to Accessory Food Factors and the Incidence of Dental Caries. By J. Sim Wallace, D.Sc., M.D., L.D.S., Lecturer on Preventive Dentistry, King's College Hospital; Formerly Dental Surgeon and Lecturer on Dental Surgery and Pathology, London Hospital, Second Edition. 228 pages; seven illustrations; price, 10 shillings and 6 pence. Published by Baillaire, Tindall & Cox, 788 Henrietta St., Covent Garden, London, England.

This book is made up largely of material read in the form of communications presented to various societies on the occasion of a trip taken by the author to America in the latter part of 1926 and early part of 1927. It is practically a restatement of his well-known theories on nutrition as it affects the development of teeth and the maintenance of health in the mouth. And it is very interesting. If what the author says is true, it will discount the theories of some of the recent research men in their claims as to a reaction on the part of tooth tissue to the attack of dental caries. He quotes the late G. V. Black as saying that "neither the density nor the percentage of lime salts, nor the strength, is in any degree a factor in predisposing the teeth to caries, or in hindering its inception or progress."

There seems to be a disposition on the part of some of our research workers to emphasize the part played by the tooth tissue in preventing decay in one instance and in inviting it in another; but there is not yet sufficient evidence to prove this contention.

The theories of Wallace are so well-known that it is merely necessary to state that the present volume is only an additional argument to strengthen his already expressed ideas.

CORRESPONDENCE

To the Editor:

At a recent meeting of The Oakland (Calif.) Dental Club a resolution was unanimously carried in which the Club expressed itself as being opposed to the divorce of orthodontia from dentistry and disapproved of the bill recently passed in Arizona creating a group for the practice of orthodontia separate from dentistry.

In other words, the Club is expressly not in favor of the practice of orthodontia being in the hands of any others except those who have previously qualified for the degree to practice general dentistry.

WALTER R. HUGHES, *President,*
HERBERT J. SAMUELS, *Secretary.*

Dec. 10, 1929.

NEWS

Resolutions Regarding New Law on Orthodontia: The following resolutions were introduced by F. M. Casto, and passed, Dec. 4, 1929, at a meeting of board of directors of the Ohio State Dental Society at Columbus, Ohio:

WHEREAS, there has been some recent discussion tending to separate the practice of dentistry into limited specialties; therefore, be it

Resolved, that the Ohio State Dental Society, in its sixty-fourth annual session, goes on record as disapproving of any legislation which tends to encourage special practice wherein the individual is not required to com-

ply with the full educational and legal qualifications as required for the practice of dentistry in its broadest sense; be it further

Resolved, that this society disapproves the recent legislation passed in the State of Arizona providing for the segregation of orthodontics from dentistry by issuing licenses for its exclusive practice. We believe that such a procedure is a dangerous precedent and a distinct backward step in the progress and advancement of the profession of dentistry; be it further

Resolved, that we would rather encourage those specializing in limited practice to first conduct a general practice before specializing, as we consider this would be quite advantageous to the practitioner and his clientele; and be it further

Resolved, that a copy of these resolutions be incorporated in the minutes of the society and published in the official bulletin, and further, that the secretary be instructed to send a copy to the secretary and to the Editor of the American Dental Association.

The resolutions are signed by H. C. Brown, J. W. Hartshorn, F. M. Casto, D. P. Snyder and J. C. McConkey.

Postgraduate Course Announced: The Loyola University, School of Dentistry, and the dental profession of New Orleans announce a course in postgraduate instruction, continuing for four days, beginning March 5. Paul R. Stillman, John Oppie McCall and G. Albert Smith will conduct the courses in periodontia; Martin Collins and Russell W. Tench, in full dentures; Clyde H. Schuyler and Edward Kennedy, in partial dentures; Albert J. Irving and Frank B. Vedder, in inlays and fixed and removable bridgework.

Columbia Receives Grant for Research: Nicholas Murray Butler announces the receipt of a grant of $35,600 from the Commonwealth Fund for research on the rôle of nutrition in pyorrhea and dental caries for the year 1930. Like amounts will be available for continuance of the work for 1931-1932. Alfred Owre, dean of the dental school of Columbia, states that all of the resources of the Medical Center at 168th St. and Broadway will be utilized by the research staff, which is headed by Charles F. Bödecker, E. C. MacBeath and H. J. Leonard, of the dental faculty.

Dental Science in New Zealand and America: Problems relating to dentistry in America, England and France were investigated by Mr. Claude H. Moses, a past president of the New Zealand Dental Association, who has returned to Auckland from a year's tour abroad. Mr. Moses believes that the dental school in Dunedin will compare favorably with any in America, which he considers leads the world in this respect. Mr. Moses visited the dental college in Paris, the largest institution of its kind in France, and he also inspected colleges in England and in the United States. "In France, practically nothing is done in treating the teeth of the poor," he said. "England is only on the fringe of this work, while in the United States I found much good work was being done." Mr. Moses said that the American dental schools were very advanced, and he was strongly of the opinion that Mr. F. C. Dodds, professor of dentistry in Dunedin, should be sent to the United States to investigate the latest methods being employed there. He found that many of the American dental schools favored an exchange of professors, and if this could be arranged in the case of New Zealand and the United States he thought it would be of great benefit to the former. He intends to take the matter up with the New Zealand Dental Association and with the authorities of the Otago School. "The teeth of the people in the United States are well looked after, and are, on the whole, better than those of the people of England," said Mr. Moses. "This is largely because the American people consume more fresh food. With regard to the controversial subject of the extraction of teeth, I found the general view among dentists in the United States is that unless a tooth showed decided signs of decay it should be conserved."—Australian letter, *J. A. M. A.,* Sept. 21, 1929.

Substandard Ether Seized by Government (Wartime Stock, Sold by War Department Under Bond Against Surgical Use Removed from Commerce): The largest shipment of ether for anesthesia ever detained by the Federal Government was seized at Bayway, N. J., recently after laboratory tests had shown that samples from a lot consisting of 108,300 quarter-pound tins were below the standards required under the Federal Food and Drugs Act. The seizure was made by the Food, Drug, and Insecticide Administration, U. S. Department of Agriculture, which enforces the Food and Drugs Act. This ether did not meet the requirements of the U. S.

Pharmacopeia, which is the standard designated by the Food and Drugs Act for drugs in interstate commerce or imported from abroad. The seized ether is part of a lot made during the World War for the Government. It was in storage until 1926, by which time it had deteriorated to such degree as to be unfit for use as an anesthetic. The War Department then sold it at a low price under bond that it was not to be used or resold for use as an anesthetic but only for technical purposes, such as in laboratories, for dry cleaning, or for fuel in starting motors. Contrary to the terms of the bond, some of this ether, labeled as anesthetic ether, was consigned to hospitals in small lots. These small lots were seized at once. Now this large shipment has been removed from the channels of trade by action under the Food and Drugs Act. Although improvement has been made in the manufacture and packaging of ether in the last few years, some ether still shows deterioration upon standing in sealed tins. For this reason authorities have been especially vigilant in the inspection of ether. Whether or not ether that has deteriorated is harmful to patients on the operating table, a matter upon which medical authorities do not entirely agree, is quite beside the point in the administration of the Food and Drugs Act. It is the duty of the officials enforcing this law to remove from interstate commerce all ether that fails to meet the standards set by the U. S. Pharmacopeia.—*U. S. Department of Agriculture.*

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Denver, Colo., July 21-25, 1930.

American Dental Hygienists Association, Denver, Colo., July 21-25, 1930.

American Dental Society of Europe, Nice, France, April 21, 1930.

American Society of Orthodontists, Nashville, Tenn., April 12-14, 1930.

Australian Dental Association, Brisbane, July 7-12, 1930.

International Dental Federation, Paris, France, August, 1931.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

April (1930)

Alabama, at Montgomery (15-17).
Connecticut, at Stamford (22-24).
Kentucky, at Louisville (7-9).
New Jersey, at Asbury Park (April 30-May 2).
North Dakota, at Bismarck (April 29-May 1).

May (1930)

Illinois, at Decatur (13-15).
Maryland, at Baltimore (5-7).
Massachusetts, at Boston (5-9).
Michigan, at Detroit (5-7).
New York, at New York City (12-16).
North Carolina, at Asheville (5-8).
Pennsylvania, at Philadelphia (6-8).
South Dakota, at Sioux Falls (12-14).
Tennessee, at Nashville (13-15).
Texas, at Fort Worth (20-23).
West Virginia, at Fairmont (19-21).
Virginia, at Richmond (12-15).

Alumni Association, College of Physicians and Surgeons, San Francisco, March 7-8, 1930.

Baltimore City Dental Society, Feb. 7-8, 1930.

University of Buffalo School of Dentistry Alumni Association, Feb. 26-28, 1930.

Central Pennsylvania Dental Society, Altoona, Feb. 26-28, 1930.

Dallas Midwinter Dental Clinic, Feb. 10-12, 1930.

Rehwinkel Dental Society, Chillicothe, Ohio, March 22, 1930.

Southwestern Michigan, at Battle Creek, Feb. 26, 1930.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Kentucky, at Louisville, June 11, 1930.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

SOUTH DAKOTA STATE DENTAL SOCIETY

The next meeting of the South Dakota State Dental Society will be held in Sioux Falls at the Cataract Hotel, May 12-14. All members of the American Dental Association are cordially invited to attend.

ERNEST W. ELMEN, *Secretary.*

AMERICAN SOCIETY OF ORTHODONTISTS

The American Society of Orthodontists will hold its twenty-ninth annual meeting at the Noel Hotel, Nashville, Tenn., April 8-11. A cordial invitation is extended to all ethical dentists who are interested in orthodontia. There will be a registration fee of $10 for nonmembers.

OREN A. OLIVER, *President.*
Nashville, Tenn.
CHARLES R. BAKER, *Sec'y-Treas.,*
636 Church St.,
Evanston, Ill.

WEST VIRGINIA STATE DENTAL SOCIETY

The next meeting of the West Virginia State Dental Society will be held, May 19-21, at Fairmont.

J. E. HERBERT, *Secretary,*
Martinsburg, W. Va.

ILLINOIS STATE DENTAL SOCIETY

The sixty-sixth annual meeting of the Illinois State Dental Society will be held in Decatur, May 13-15.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

The annual meeting and examination of the Kentucky State Board of Dental Examiners will be held at Louisville, Ky., at the dental college, June 11. Address communications to

ROBERT L. SPRAU, *Secretary,*
970 Baxter Ave.,
Louisville, Ky.

NORTH DAKOTA STATE DENTAL ASSOCIATION

The next meeting of the North Dakota State Dental Association will be held at Bismarck, April 29-May 1.

L. I. GILBERT, *Secretary,*
Fargo.

ALUMNI ASSOCIATION, COLLEGE OF PHYSICIANS AND SURGEONS

The annual meeting of the Dental Alumni Association of the College of Physicians and Surgeons of San Francisco will be held at the college, Friday and Saturday, March 7-8. Preceding the general sessions there will be eight different special courses given. March 6 will be given over to golf, luncheons and class reunions. A banquet will be given at the Bohemian Club, Saturday evening, March 8. A cordial invitation is extended to all ethical dentists.

DON J. AUBERTINE, *Chairman,*
Publicity Committee,
291 Geary St.,
San Francisco, Calif.

REHWINKEL DENTAL SOCIETY

The Rehwinkel Dental Society (comprising Athens, Clinton, Fayette, Gallia, Highland, Hocking, Jackson, Meigs, Pickaway, Ross and Vinton counties, Ohio) will meet in Chillicothe, at the Masonic Temple Building, Saturday, March 22. Among the essayists and clinicians is George B. Winters, of St. Louis, Mo.

WILLIAM G. HAMM, *Sec'y.-Treas,*
19 S. Paint St.,
Chillicothe, Ohio.

SOUTHWESTERN MICHIGAN DENTAL SOCIETY

Post Tavern, Battle Creek

Wednesday, Feb. 26, 1930

10:00 a.m.—Dentistry as a Business
By Edwin N. Kent, Boston, Mass.

12:15 p. m.—Luncheon, followed by an address by Raleigh R. Stotz of Grand Rapids, Mich., on "The Destiny of Dollars."

2:00 to 4:30 p. m.—Round Table Talk.
By Edwin N. Kent.

6:00 p. m.—Banquet.

8:00 p. m.—The Dentist and the Law
By Edwin N. Kent.

This meeting will be open to all dentists who have their 1930 American Dental Association membership cards, or to any dentist who wishes to make application for membership in the American Dental Association

at that time; their wives and dental assistants.

EMORY W. MORRIS, *Chairman,*
Program Committee,
401 Post Bldg.,
Battle Creek, Mich.

DENTAL SOCIETY OF THE STATE OF NEW YORK: PRELIMINARY PROGRAM

The Dental Society of the State of New York will hold its sixty-second annual meeting in New York City, May 12-16. All literary exercises, clinics and commercial exhibits will be held at the Hotel Commodore. Thomas C. Swift, 1 Park Ave., Mt. Vernon, is chairman of the Exhibit Committee; Harvey J. Burkhart, 800 E. Main street, Rochester, chairman of the Program Committee, and J. W. Schelpert, 30 Cottage Ave., Mt. Vernon, chairman of the Clinic Committee.

The first two days of the session, namely: Monday and Tuesday, May 12 and 13, will be devoted to educational clinic classes. The fee for these classes, although not definitely settled in each case, will be lower than it has been on any previous occasion.

The following are on the literary program: George B. Winter, St. Louis; John V. Mershon of Philadelphia; Thomas B. Hartzell, Minneapolis; Sherman W. Davis, Indianapolis, and J. L. Appleton, Jr., Philadelphia.

During the time of the meeting, sessions of the Dental Hygienists Association and the Dental Assistants Association will be held on the mezzanine floor of the hotel.

WILLIAM C. FISHER, *President,*
A. P. BURKHART, *Secretary,*
57 E. Genesee St.,
Auburn, N. Y.

JOINT MEETING OF PHYSICIANS AND DENTISTS

The medical societies of the counties of Kings and of Queens and the Second District Branch of the Dental Society of the State of New York have arranged a joint meeting to be held in the building of the Medical Society of the County of Kings, 1313 Bedford Avenue, Brooklyn, New York, during the afternoon and evening of March 10, 1930. An invitation is extended to all practitioners of medicine and dentistry to attend the meeting. Following is the program:

3:00 p. m.—Cooperation of the Physician and Dentist in the Recognition of Disease.

Fifteen minutes will be given to (1) the point of view of the physician; (2) the point of view of the dentist, and (3) a discussion of this and the paper following.

4:00 p. m.—What Justifies the Dentist and Physician in Advising the Extraction of a Tooth?

6:00 p. m.—Dinner.

8:30 p. m.—Scientific Session.
Oral Conditions and General Health.

Thirty minutes will be given, each, to the dentists' and physicians' points of view and the discussion.

DENTISTS IN GENERAL LITERATURE

The undersigned has in preparation a list of the nonprofessional writings of dentists, this list to form later the basis of a paper showing the extent to which our profession has contributed to the field of general literature. It is planned to include the titles of all fiction (novels, or stories in periodicals); essays, biographies, poetry, and articles or books on scientific subjects (not medical or dental).

Will authors kindly supply the following data: Title; if a book, give size, binding, number of pages, place and date of publication. If in a periodical, give title of article, name of periodical, with month and year, and pages occupied.

Contributions to this list will be appreciated and acknowledged by

ALFRED P. LEE,
235 South Fifteenth Street,
Philadelphia, Pa.

VIRGINIA STATE DENTAL ASSOCIATION

The next meeting of the Virginia State Dental Association will be held in Richmond, May 12-15.

J. E. JOHN, *President,*
Shenandoah Life Bldg.,
Roanoke

A. M. WASH, *Sec'y-Treas.,*
Medical Arts Bldg.,
Richmond

SOUTHWESTERN SOCIETY OF ORTHODONTISTS

The Southwestern Society of Orthodontists will hold its tenth annual meeting in Oklahoma City, Okla., Feb. 24-26, 1930.

CURTIS WILLIAMS, *Secretary,*
716 Medical Arts Bldg.,
Shreveport, La.

KENTUCKY STATE DENTAL ASSOCIATION

The sixty-first annual meeting of the Kentucky State Dental Association will be held in Louisville at the Brown Hotel, April 7-9.

FRANK B. HOWER, *Secretary,*
Heyburn Bldg.,
Louisville

AMERICAN DENTAL ASSOCIATION

Denver, Colorado. July 21-25, 1930.

HOTEL RESERVATIONS

In securing hotel reservations for the 1930 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation which they have made for you.

Kindly indicate second and third choices.

Please remember that reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, please write or wire the hotel releasing it.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, DENVER, COLO., JULY 21-25, 1930.

.....Hotel. 1930

Please reserve sleeping room accommodations noted below:

.....Room(s) with bath for.....people. Rate desired $.....
(per day)

.....Room(s) without bath for.....people. Rate desired $.....
(per day)

Second choice: .....

Third choice: .....

ROOMS TO BE OCCUPIED BY: ADDRESS IN FULL

.....

.....

.....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

IMPORTANT TO HOTEL MANAGER: In the event you cannot accept this reservation, please forward this application at once to Dr. I. R. Bertram, Chairman Halls and Hotels, 1222 Republic Bldg., Denver, Colorado, who will attend to its assignment.

HOTEL	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
ADAMS 18th & Welton	115	$3.00-5.00	$4.00-6.00	$2.00-2.50	$3.00-4.00
AMBASSADOR 1728 California	92	2.00	2.50	1.50	2.00
ALBANY 17th & Stout	300	3.00-6.00	5.00-10	2.00-3.00	4.00-6.00
ARGONAUT 233 E. Colfax	160	4.00	5.50	2.00	3.00
AUDITORIUM 14th & Stout	200	2.00-3.50	3.00-5.00	1.50-2.00	2.50-3.00
AYRES 1441 Logan	75	3.50 up	5.00-6.00	2.50	4.00
BROWN PALACE 17th & Tremont	300	5.00 up	8.00 up		
COLBURN 10th & Grant	100	3.50-5.00	5.00-8.00		
COLORADO 17th & Tremont	100	2.50-3.00	4.00-5.00	1.50-2.00	2.50-3.00
COSMOPOLITAN 18th & Broadway	460	3.00-5.00	5.00-10.00	1.50-2.00	2.50-4.00
CREST 1924 Welton	114	2.00 up	3.00 up	1.50	2.00
EDELWEISS 1651 California	76	3.00	4.00	2.00	3.00
HARVARD 501 E. Colfax	60	2.50	3.50	1.50	2.50
KENMARK 530 17th	120	2.50-3.50	4.00-6.00	1.50-2.50	2.50-4.00
LANCASTER 1765 Sherman	75	2.50	3.00-5.00	2.00	2.50
MARQUETTE 1725 Curtis	62	2.00	4.00	3.00	3.00
MAYFLOWER 1710 Grant	80	2.50-3.50	3.50-5.00	1.50-2.00	3.00-3.50

(Continued on Next Page)

HOTEL	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
MIDLAND 1106 17th	70	3.00	4.00	1.50-3.00	2.00-3.00
MILLS 1321 Logan	60	2.50	4.00	1.50	2.00
NEWHOUSE 1470 Grant	77	3.00	5.00	2.00-2.50	3.00-3.50
OLIN 1420 Logan	125	2.50-4.00	6.00		
O'NEILL 1407 Stout	60	2.00	3.50	1.50	2.50
OXFORD 1612 17th	250	3.50	5.00	2.00	3.50
PAGE 1320 Stout	65	2.00-2.50	3.00-3.50	1.50	2.00
PARK LANE 450 S. Marion			10.00		
PLAZA 330 15th	60	2.00-2.50	3.00-3.50	1.50	2.00-2.50
SEARS 1755 California	94	2.50-3.00	3.00-8.00	2.00	2.50-3.00
SHIRLEY-SAVOY 17th & Broadway	400	3.00-5.00	5.00-8.00	2.00-2.50	3.50-4.00
STANDISH 1530 California	125	2.50	3.50	1.50	2.50
WELLINGTON 1450 Grant	75		3.50		
WEST 1337 California	112	2.50	3.50	1.25-1.50	2.00-2.50
WYNNE 1431 California	100	2.00 up	3.00 up	1.50	2.00
WEST COURT 1415 Glenarm Place	129	2.50 up	3.00 up	1.50	2.00

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